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When Demand Increases Cause Shakeouts†

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Standard models that guide competition policy imply that demand increases should lead to more, not fewer firms. However, Sutton's (1991) model shows that demand increases instead can lead to shakeouts if non-price competition takes the form of fixed investments. We investigate this effect in the 1960s–1980s hotel and motel industry, where quality competition arose through investments in swimming pools. We show that demand increases associated with highway openings led to fewer firms, particularly in warm places. We do not find this effect in other industries that serve travelers, gasoline retailing, and restaurants, where quality competition does not involve fixed investments. (*JEL* G34, K21, L13, L15, L40, L83)

A long tradition in industrial organization and antitrust law associates increases in market concentration with decreases in competition (Bain 1956). This tradition underlies concerns among policymakers in the United States and the European Union that recent increases in concentration across industries—including those where demand is almost certainly increasing—indicates that "competition may be decreasing in many economic sectors."[1] Combined with research that concludes that price-cost markups have been increasing across a wide range of industries (e.g., De Loecker and Eeckhout 2017, 2018), these trends have led some observers, including US Senators, to argue that consumers would benefit from a more aggressive competition policy.[2]

Economists have long understood, however, that the relationship between concentration and competition runs in both directions. Increases in concentration —industry shakeouts—can be a *manifestation* of competition (Demsetz 1974). Industry structure models accommodate this bidirectional relationship by allowing the number of firms in an industry or market to be endogenous and be influenced by demand-side factors such as product differentiation that affect how strongly firms

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[1] See Council of Economic Advisers (2016).

[2] Shapiro (2018) reports that the "new conventional wisdom" is that competition has declined in the US economy. In late 2017, US Senator Amy Klobuchar, joined by nine cosponsors, introduced legislation to "modernize antitrust enforcement," commenting that "[e]conomic concentration is driving up costs for consumers and driving down innovation in business." See https://www.klobuchar.senate.gov/public/index.cfm/2017/9/klobuchar-senators-introduce-legislation-to-modernize-antitrust-enforcement.

compete. A common approach is to model the competitive process in two stages: one in which firms choose whether to enter, and a second in which they compete on price (e.g., Dixit and Stiglitz 1977 and Salop 1979). These models generate the result that increases in demand should (weakly) lead to increases in the number of firms. As applied to competition policy, this appears to provide additional support for the policy-related concern described earlier: one should not observe shakeouts in industries where demand is increasing, and if one does, this is likely due to a lack of competition or to anticompetitive acts by incumbents that inhibit the competitive process.

Sutton's (1991) work, however, shows that this result from this class of models is dependent on a critical assumption about how firms compete. In particular, it does not hold when firms have the ability to engage in quality competition, and make investments in fixed costs that increase quality. In such an environment, positive demand shocks can lead to shakeouts because they catalyze firms to invest more; as demand increases, fixed cost investments in quality can be scaled across a larger customer base. Higher quality firms gain market share at the expense of lower quality incumbents and potential entrants face tougher competitors. As a consequence, unconcentrated outcomes that might be possible in smaller markets, where firms are not competing as strongly in quality, may not be equilibrium outcomes in larger markets, where firms are doing so. If so, neither increases in concentration (nor increases in markups) imply a decrease in competition. They might instead reflect that the way the firms compete has changed, though how strongly they compete has not or even has increased.

This implication of Sutton's work—that demand increases can lead to shakeouts—has not yet been demonstrated empirically. This paper does so. Our work examines the US hotel and motel industry in the mid-to-late twentieth century.[3] This context provides critical empirical variation, as during this period, the United States' Interstate Highway System was built, and highway sections were completed and opened in different non-urban areas at different times. We first provide evidence that the completion of interstate highways resulted in a local demand shock for lodging, showing that it is associated with increases in hotel employment. We then investigate how local industry structure adjusts to these shocks; we show that highway completion leads to fewer (but larger) hotels. On average in our sample of local markets, our evidence indicates that the completion of highways led to demand increases, but shakeouts.

We then further investigate the mechanism behind this result. We note that an increasingly important element of quality provision in the lodging industry at this time took the form of whether firms supplied recreational amenities such as swimming pools. Installing a swimming pool enhances a hotel's quality, but requires a substantial fixed cost investment. The extent to which a hotel's quality is enhanced by a swimming pool is not equal across regions, however. In warmer areas, a swimming pool has more of an impact on quality because it can be used

[3] For simplicity, we will refer to both hotels and motels as "hotels" unless this distinction is important. Our primary data sources do not distinguish between the two.

during more of the year. The returns to the fixed investment therefore are greater than they would be in a colder area.[4]

To further establish the connection between shakeouts and quality competition, we examine whether the connection between higher demand for lodging and shakeouts is stronger in warmer areas than in colder areas. We show that the extent to which hotel employment increased with highway completion is the same in warmer and cooler regions; there is no evidence that the size of the demand shock associated with highway completion differed. However, highway completion only led to shakeouts in warmer regions—in colder regions, the number of hotels continued to increase as lodging demand grew. We infer that competition among firms through fixed investments in quality enhancements was more effective and prevalent in the warmer regions, precipitating consolidation. As a result, the positive demand shock in these regions led to fewer (but larger) hotels than in the places that were too cold to enjoy swimming for most of the year.

Finally, we provide further evidence on quality competition and changes in market structure by adopting a strategy similar to Berry and Waldfogel (2010). We investigate whether these effects appear also when looking at gas retailing or restaurants, industries where quality competition is either less important or quality is supplied primarily through variable costs rather than fixed costs. Unlike for hotels and motels, we find no evidence that highway completion is associated with shakeouts in these industries.

Our results reinforce the importance of understanding the various dimensions along with firms potentially compete when assessing whether increases in concentration (or markups) imply decreases in competition, or are manifestations of competition. What one can infer about increases in concentration, even in industries where demand is increasing, depends on the dimensions along which firms compete and whether these dimensions have changed over time. To this point, we doubt that observers of the hotel and motel industry during the time we study would have associated the shakeouts we observe in the warmer local markets we study with a decrease in competition. They would likely have observed that the new motels that were entering these local markets at the time were larger and higher quality than the ones they replaced, concluding that the decreases in the number of hotels were due to these newer, larger hotels' success in attracting customers, and that important elements of quality competition among the hotels that remained in the market (e.g., swimming pools) involved fixed cost investments.[5] However, to reach this conclusion, such an observer would have to move beyond evidence on concentration and price-cost margins and take seriously the idea that hotels and motels compete on dimensions other than price.

[4] At this time, indoor pools were rare; nearly all pools at hotels or motels were outdoor pools.

[5] They also may have observed that travelers were becoming less likely to stay at friends and relatives and more likely to stay at hotels and motels during this time. Surveys by the US Travel Data Center report that the share of long-distance trips in which travelers stayed at friends' or relatives' homes declined from 47 percent in 1972 to 37 percent in 1992, while the share in which they stayed in hotels or motels increased. This increase in the attractiveness in staying in hotels and motels is inconsistent with the hypothesis of a decrease in competition. See US Travel Data Center (1974, 1992).

This is no less important today. Distinguishing between mergers that reflect changes in how firms compete, but not necessarily decreases in competition, and mergers that lead to decreases in competition is challenging. Sound competition policy analysis requires one to assess how firms in an industry compete, not only on price but in other dimensions, and how competitive incentives on all of these dimensions may have changed over time. There are no shortcuts.

Our paper is related both to our own previous work (Campbell and Hubbard 2016, Mazzeo 2002a, b) on interstate highway openings and industry structure in gas retailing and competition and industry structure in rural hotel markets, respectively, and to several long literatures on the determinants of industry structure and its relationship to competition. Like Sutton (1991), it connects to the structure/conduct/performance paradigm of Bain (1956), subsequent critiques of this paradigm (Demsetz 1974), and early game-theoretic models of imperfect competition and its connection to industry structure (e.g., Spence 1976, Dixit and Stiglitz 1977, Salop 1979, and Fudenberg and Tirole 1986). Empirically, its investigation of the relationship between market size and market structure is similar in spirit to Bresnahan and Reiss (1990, 1991), Berry (1992), and Campbell and Hopenhayn (2005), though these earlier papers examine cross-sectional rather than time series relationships between market size and market structure. It is also closely related to empirical studies that test propositions from Sutton (1991) (e.g., Ellickson 2007, George 2009, and Berry and Waldfogel 2010). Finally, it is related to several papers in urban economics and international trade that use the same interstate highway construction data that we use to examine interstate highway construction's broader effects (Chandra and Thompson 2000, Baum-Snow 2007, Michaels 2008).

The rest of the paper is organized as follows. Section I describes the analytical framework, focusing particularly on the relationship between market structure and market size. We discuss the conditions under which this relationship is non-monotonic, leading to the possibility that increases in market size can lead to shakeouts. Section II describes general features and trends in the hotel and motel industry during the time period that is the focus of this study, the 1960s–1980s. The facts discussed in this section help frame our main empirical analysis, and rule out some potential explanations of why increases in demand might be associated with decreases in the number of firms during this time. Section III describes our data, which are from County Business Patterns and the Department of Transportation's PR-511 file; the former describes the number and size distribution of hotels and motels, by year and county, and the latter reports the date that each segment of the United States' Interstate Highway System opened. Section IV describes our empirical specifications and presents our main results. Section V concludes.

I. Market Size and Industry Structure

Our analytical framework draws from Shaked and Sutton (1987) and especially Sutton (1991). Sutton's (1991) theory focuses squarely on the relationship between market size and market structure and its connection to quality competition. He distinguishes between two types of industries. One is industries where sunk costs are exogenous. In these industries, production requires firms to incur fixed

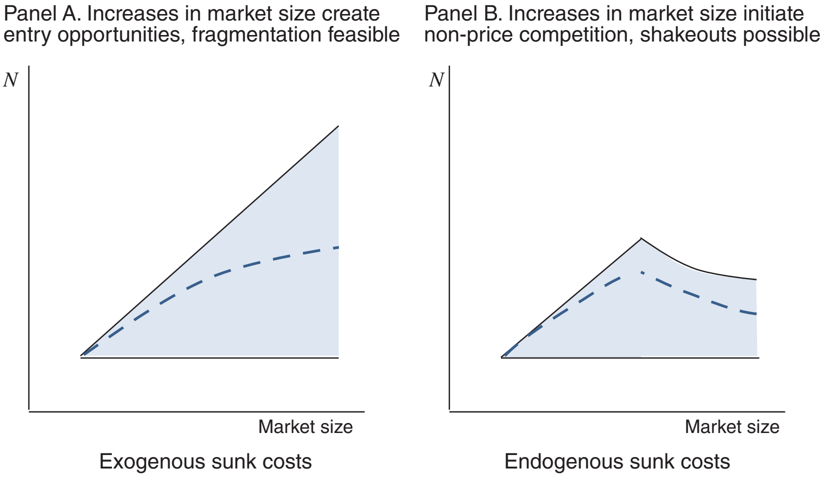

Figure 1. Increases in Market Size Can Lead to Shakeouts

Notes: The shaded area in panel A of this figure illustrates feasible equilibrium outcomes in the case of "exogenous sunk costs"; as market size increases, fragmented outcomes (i.e., where N is high) become feasible. The shaded area in panel B of this figure illustrates feasible equilibrium outcomes in the case of "endogenous sunk costs"; here, fragmented outcomes do not become possible as market size increases, and the equilibrium number of firms converges to a finite level. The dashed lines depict possible relationships between market size and the number of firms. Panel B illustrates that, under certain conditions, after some threshold where firms begin to compete on quality, the number of firms can decrease as market size increases.

costs—for example, the set-up costs associated with a production plant—but firms have no incentive to incur such costs beyond what is necessary to produce. Investing further does not increase the real or perceived quality of firms' products. The other type of industry is where sunk costs are endogenous. In these industries, firms can have an incentive to incur fixed costs beyond what is necessary to produce—for example because doing so increases their products' real or perceived quality.[6]

Sutton's central result is that the relationship between market size and market structure is different for these two types of industries. We depict this difference in Figure 1. In industries where sunk costs are exogenous, increases in market size create entry opportunities and lead the equilibrium number of firms to (weakly) increase. More firms can fit in the market as market size increases. In these industries, fragmented outcomes where many firms serve a particular market are possible as market size becomes large. In contrast, in industries where sunk costs are endogenous, fragmentation is not an equilibrium outcome, even as market size becomes large. The reason for this is that as market size increases, firms' incentives to incur additional fixed costs increase as well—the potential returns to

[6] Sutton (1991) emphasizes advertising and research development expenditures as examples of endogenous sunk costs, but others have investigated how endogenous sunk costs arise from other dimensions of quality competition (for example, Ellickson 1997 and Berry and Waldfogel 2010).

incremental investments in quality are greater when market size is larger because such fixed investments can be applied to a larger customer base. Increases in this form of non-price competition serve to limit the number of viable firms, however. In equilibrium, firms must have higher variable profits in order to cover these increased fixed costs, and firms cannot achieve higher variable profits if the number of firms is large.

In his book, Sutton emphasizes two features of this central result. “The first is... [that] increases in market size do not lead to an indefinite fall in concentration. The second feature relates to the fact that the market size/market structure relationship is not even necessarily monotonic” (Sutton 1991, p. 60). This non-monotonicity means that increases in market size can lead to shakeouts. Later in this paper, we will provide evidence that this effect helps explain long-run historical changes in industry structure in the US hotel/motel industry. Because this effect has not been the focus of the various empirical studies that have followed Sutton, we discuss it next in more detail.

Increases in market size can lead to shakeouts because industries can effectively shift from being “exogenous sunk cost industries” to “endogenous sunk cost industries” as market size increases. When market size is small (enough), no firm has an incentive to incur additional fixed costs that increase the quality of its offerings, even if no other firm has done so—the potential returns are low because the potential increase in a firm’s sales are low relative to the incremental fixed costs needed to increase quality. As long as this is true, the market size/market structure relationship is like that in exogenous sunk cost industries, and increases in market size will tend to lead to more firms. However, as market size increases, at some point, demand becomes great enough so that it becomes profitable for one firm to deviate and incur additional fixed costs toward attracting additional customers. At this point, the competitive dynamics change and the market size/market structure relationship is no longer like that in exogenous sunk cost industries. Once firms begin to compete in this way—they compete on quality where quality is produced through fixed costs—fragmented outcomes that may have been possible even when market size was smaller are no longer equilibrium outcomes. As market size increases further, the number of firms can decrease. (See Figure 1.) Increases in market size can lead to shakeouts because such increases can change an industry’s competitive dynamics. Such increases enhance firms’ incentives to engage in non-price competition, and a consequence of increased non-price competition can be that fewer firms can “fit in the market” (i.e., have variable profits that at least cover their fixed costs) than when market size was smaller and firms did not have as strong an incentive to compete in this way.

As Sutton and especially Berry and Waldfogel (2010) have emphasized, the fact that quality competition is in the form of fixed costs rather than variable costs is essential for Sutton’s central result. When quality competition takes the form of fixed costs, firms’ marginal costs are independent of their quality, and a high-quality firm has low enough marginal costs so that it can successfully compete not only for quality-sensitive customers, but also for less quality-sensitive customers. This means that increases in market size—even when these increases are only in more quality-sensitive customers—can nevertheless have competitive implications for incumbent firms that serve less quality-sensitive customers. By increasing firms' incentives to make fixed cost investments in their quality, increases in market size can enhance high-quality firms' ability to compete for all customers. In contrast, when quality competition takes the form of variable costs, the competitive implications of increased quality competition are different. Increases in market size lead to more firms and lead to a broader spectrum of quality produced in the market. High-quality firms' marginal costs are higher than low-quality firms' marginal costs, and this limits their ability to compete successfully for customers who are not quality sensitive. Similar to the exogenous sunk cost case described earlier, increases in market size will tend to lead to more firms.[7]

II. Hotels and Motels: Basic Patterns

We begin by describing general trends in the US hotel industry from the 1960s through the early 1990s, the time period of our empirical analysis. These general trends come from published census reports, including County Business Patterns and the Economic Census. Reports from the Economic Censuses provide key background facts because, although these generally only took place every five years, the surveys the census sent to hotels and motels asked unusually detailed questions about hotels' and motels' characteristics. These background facts help shape our interpretations of our main analyses, which use data from County Business Patterns on firm counts and employment—these are annual and publicly available but do not contain detail about hotels' and motels' characteristics beyond their employment size.

Figure 2 uses data from County Business Patterns to show basic trends in industry employment and the number and size of hotels and motels. The top panel shows that employment expanded in this industry during the 1960s, 1970s, and 1980s, increasing by 270 percent between 1964 and 1992. The bottom shows that much of this expansion came in the form of larger hotels and motels, rather than more hotels and motels. In fact, the number of hotels and motels decreased by 15 percent between 1964 and 1981, before recovering to its 1964 level in the late 1980s.[8] In contrast, the average number of employees per hotel/motel steadily increased throughout this period. The average number of employees per hotel/motel in 1992 was about two-and-a-half times larger than in 1964.

These changes in averages reflect more nuanced changes in the composition and characteristics of hotels and motels during this time. We are able to isolate these nuances using the more detailed data collected every five years in the

[7] Berry and Waldfogel (2010) illustrates this difference by comparing the relationship between market size and the number and quality of newspapers (where quality is produced largely with fixed costs) and restaurants (where quality is produced largely with variable costs) in US metropolitan areas. They find that as market size increases, the number of newspapers changes little but their quality increases. In contrast, they find as market size increases, both the number and variety of restaurants increases. They conclude that these patterns are consistent with the implications of Sutton's model on the relationship between market size and product quality. Later in this paper, some of our empirical work will exploit a similar strategy to Berry and Waldfogel as we contrast the relationships we uncover between market size and the number of firms in the hotel industry with those in the restaurant industry.

[8] This count only includes the number of hotels with positive numbers of employees. Including non-employer hotels in the analysis would lead the decrease to be greater.

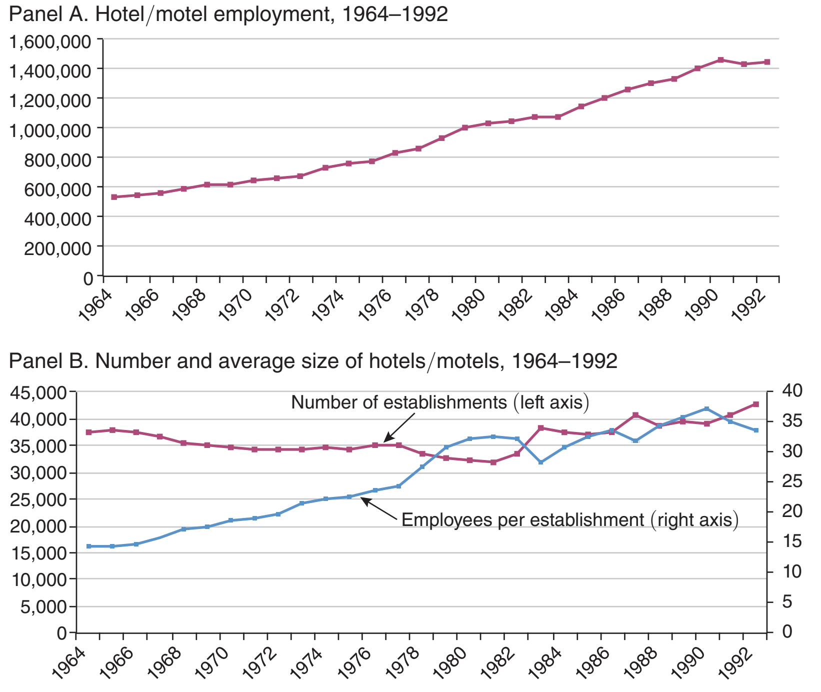

Figure 2. Hotel/Motel Employment and the Number and Size of Hotels/Motels, 1964–1992

Source: County Business Patterns, various years

Economic Census of the industry. Figure 3 shows the distribution of establishments by number of guest rooms, and by whether they are hotels or motels in 1963 and 1982. This figure shows an increase in the establishment share of motels relative to hotels, and particularly an increase in the share of larger motels during this time. For example, in 1963, only 7 percent of hotels and motels were motels with at least 50 rooms; in 1982, 28 percent were. In contrast, the share of hotels and motels with fewer than 25 rooms declined over this period from 50 percent to 30 percent. In sum, there was a shift from small motels and hotels to large motels during this time.

While hotels' and motels' primary service is lodging, many have on-site restaurants and/or recreational facilities. Restaurants, however, were becoming less important relative to rooms as a source of revenues during this time. The top part of Table 1 reports that food and beverage sales made up 34 percent of hotels'/motels' revenues in 1963. This figure fell to 26 percent in 1982.[9] The bottom part of the table reports these shares, only including motels. The pattern is similar; the food and beverage revenue share fell from 22 percent to 19 percent during this time. Although motels

[9] The large increase in the share of revenues from "other" reflects increases in revenues from casinos. The right-most column reports the ratio of food and beverage revenues to room revenues; the fall in this ratio confirms that food and beverage revenues declined relative to room revenues during this time.

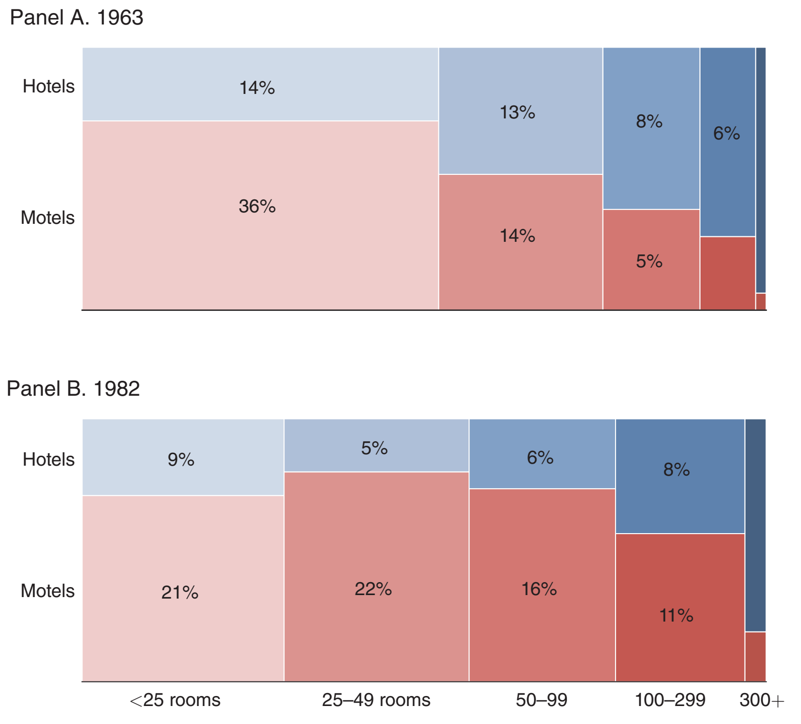

Figure 3. Establishment Shares of Hotels/Motels by Number of Guest Rooms, 1963 and 1982

Source: Census of Services, 1963 and 1982

were becoming larger during this time, there is no evidence a greater share of them had restaurants.

In contrast, recreational facilities, especially swimming pools, were becoming more common, especially in the south. Table 1 reports the share of hotels and motels with any recreational facility and with a swimming pool and/or private beach. Thirty percent of hotels and motels reported having some form of recreational facility in 1963; by far the most common recreational facility was a swimming pool. Twenty-three percent of hotels and motels, and 28 percent of motels, reported that they had a swimming pool. This share increased significantly during our sample period. By 1972, over half of hotels and motels had either a swimming pool or private beach (mostly, we suspect, the former). The increase in the share of hotels and motels with a pool or private beach was larger in warmer states. Figure 4 plots the share of hotels and motels with a pool or beach in each state against the average temperature in the state. The share with a pool or beach is higher in warmer states in both 1963 and 1972, but the increase between 1963 and 1972 tended to be greater in warmer states—as indicated by 1972's steeper regression line.

A well-known trend during this time period is the emergence of large motel chains, including most famously Holiday Inn. Figures from the Economic Census indicate that an increasing share of motels was affiliated with a chain during our

Table 1—Sources of Revenues and Recreational Facilities: Hotels and Motels, Various Years

	Rooms	Food and beverage	Other	Food and beverage/rooms
Panel A. Sources of revenues				
Hotels and motels				
1963	61%	34%	5%	0.56
1982	59%	26%	15%	0.44
Motels only				
1963	75%	22%	3%	0.29
1982	78%	19%	4%	0.24
	Share with...			
	Any recreational facility	Swimming pool	Private beach	Pool or beach
Panel B. Recreational facilities				
Hotels and motels				
1963	30%	23%	5%	
1967	37%	32%	7%	
1972				51%
Motels only				
1963	32%	28%	4%	
1967	43%	38%	6%	
1972				55%

Notes: "Motels" includes "motels" and "motor hotels" in 1963 and "motels," "motor hotels," and "tourist courts" in 1982. Additionally, 1963 includes only hotels with 25 or more guest rooms and motels with 10 or more guest rooms; these hotels/motels made up over 97 percent of industry revenues. "Recreational facility" includes swimming pool, boating, private beach, golf course, tennis court, horseback riding, and skiing.

Source: Census of Services, 1963, 1967, 1972, and 1982

sample period, and that chain-affiliated motels were much larger than unaffiliated motels. The share of motels that was chain-affiliated increased from 9 percent in 1967 to 18 percent in 1977, and chains' share of motel revenues increased from 30 percent in 1967 to 48 percent in 1977.[10] However, there is no evidence that these increases in affiliation differed between warmer and cooler states. Figure 5 depicts the relationship between chains' share of total motel revenues in 1967 and 1977 and average temperature, by state. The figure shows that it increased by about 20 percentage points across the temperature spectrum. Unlike what we showed for swimming pools in Figure 4, the expansion of motel chains during this time was similar in the south and north.[11]

[10] The growth in these shares then slowed; chains made up 21 percent of motels and 45 percent of motel revenues in 1982.

[11] Differences in the years in Figure 5 and Figure 4 reflect that the Economic Census' survey forms changed from year to year; the census did not ask about chain affiliation until 1967 and did not ask about recreational facilities after 1972.

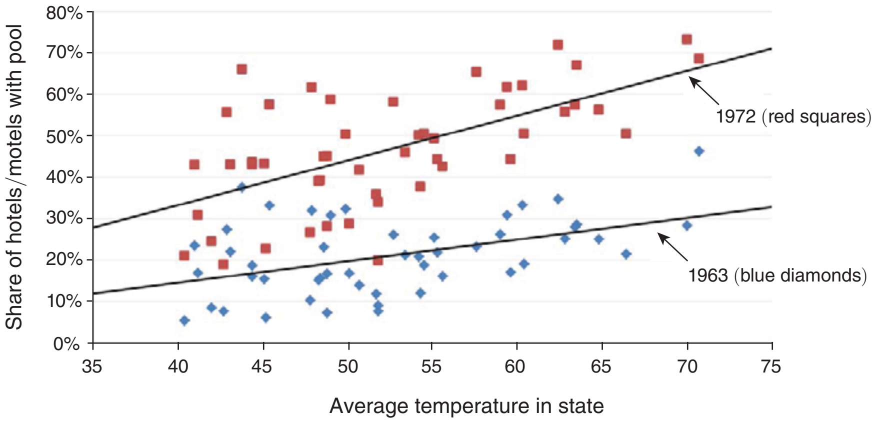

Figure 4. Share of Hotels/Motels with Pool or Beach by Average State Temperature, 1963 and 1972

Source: Census of Services 1963 and 1972; https://www.currentresults.com/Weather/US/average-annual-state-temperatures.php

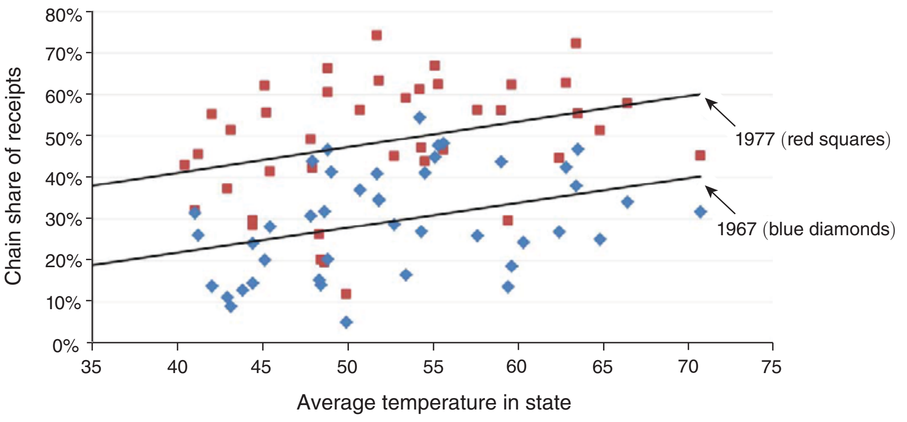

Figure 5. Chain Share of Motel Revenues, 1967 and 1977

Source: Census of Business 1967; Census of Services 1977; https://www.currentresults.com/Weather/US/average-annual-state-temperatures.php

III. Data Sources and Sample Structure

A. *Establishments and Employment*

Our main data sources are the same as in Campbell and Hubbard (2016). We obtain county-level data on hotel employment, the total number of hotels, and the number of hotels in different employment-size categories from the Bureau of the Census' County Business Patterns, annually from 1964–1992.[12] These data provide

[12] Hereafter, to simplify language, we will use the term "hotels" to mean "hotels and motels." Unlike the Economic Census that had more detailed property-level characteristics, County Business Patterns does not distinguish between the two.

our main dependent variables, including the number and average employment size of hotels in US counties.[13]

Along with data on hotels, we also collect analogous data on two other industries: "eating and drinking places" ("EDPs"; i.e., restaurants and bars) and "gasoline retailing." We use these other data in "falsification exercises" to investigate the hypothesis that the relationships we observe between highway openings and changes in industry structure in hotels reflect competitive effects that one would expect to observe in the hotel industry but not these other industries.

B. *Highway Openings and Completion*

We combine the data on establishments and employment with highly detailed data on interstate highway openings. The construction of the Interstate Highway System followed the passage of the Federal Aid Highway Act of 1956. The goal of this legislation was to create a robust transportation for purposes of economic growth and civil defense. A substantial network of roads had been built prior to the 1950s, as the automobile diffused throughout the US population, but these roads were often slow, winding through small towns and crossed by many intersections. The newly constructed Interstate Highway System would be considerably more efficient by improving construction standards and eliminating cross-traffic by restricting access to junctions with other roads to highway exists (often miles apart). The system was pieced together over the next decades. In some places, existing roads were simply improved; in others, new stretches of highway were built requiring more substantial investment. With better, speedier roads came more traffic, both substituting from the original slower roads and from new vehicle trips stimulated by the improved infrastructure.

As discussed at length in Campbell and Hubbard (2016), provisions of the Highway Act encouraged highway construction to be evenly paced across states, and states tended to build highways first in areas where through traffic was leading existing roads to be congested.[14] As a consequence, there was not a strong tendency, at least when looking outside of highly urbanized areas, for interstate highways to be completed sooner in areas where economic growth was expected to be greater. Campbell and Hubbard (2016) tests this by examining whether county employment (across all industries) is related to the timing of highway completion in their sample of non-urban counties (which is larger, but similar to what we examine here), and find no evidence of such a relationship.

[13] Before 1974, the census reported the number of firms operating hotels in each county, rather than the number of hotels. This has a small effect on our analysis because it is uncommon for firms to operate multiple hotels in the same county in our sample counties. (It is much more common for a chain to have multiple hotels in a county which are operated by separate franchisees.) Later in this paper, we describe how we account for this in our empirical framework. Here and throughout, we will use the word "hotels" rather than the phrase "firms operating hotels" to discuss this variable, even though the latter is more accurate before 1974.

[14] The placement and construction of roads in the non-urbanized areas that we examine was generally un-controversial because it generally relied on existing rights of way and undeveloped land was usually plentiful. This was not the case in some large cities, such as Boston, Washington, and San Francisco, where opposition led some interstate highway segments not to be completed.

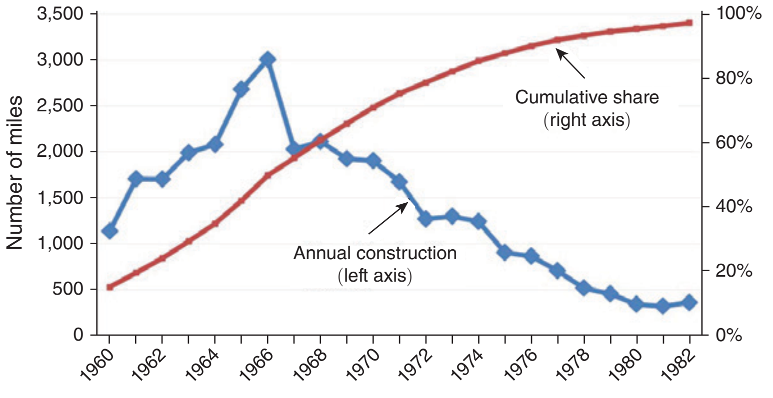

Figure 6. One- and Two-Digit Interstate Highway Construction, 1960–1982

Source: PR-511, authors' calculation

Our research strategy treats highway openings as demand shocks. In our empirical discussions, we will treat highway openings as econometrically exogenous shocks, as this is consistent with both our understanding of the institutional context and with previous work that has found no evidence of the "reverse causation" alternative that both highway construction and the growth of hotels in a county reflect common shocks that affect both independently.[15]

Our empirical analysis focuses on the relationship between the local demand shock created by interstate highway openings and changes in the number and size distribution of hotels and motels. Figure 6 summarizes the timing of the opening of one- and two-digit interstate highways between 1960 and 1982.[16] Interstate highways opened for use in discrete segments during this period, often non-contiguously, typically in 5–15 mile sections. We observe the opening date of every mile of the Interstate Highway System using data from the US Department of Transportation's "PR-511" file. About 15 percent of the mileage had opened by the end of 1960, 35 percent by the end of 1964, 75 percent by the end of 1971, and 97 percent by the end of 1982. Highway openings peaked in 1965 and 1966, remained at over 1,000 miles per year through 1974, then dwindled thereafter. After 1983, fewer than 100 miles per year of new two-digit interstate highways were opened. Our data on hotels and motels extend through the early 1990s—allowing us to investigate long-run relationships between highway openings and industry

[15] However, even if one were to relax this treatment, many of our results revolve around differences in effects, and alternative interpretations of these effects that do not treat highway openings as exogenous would be based on factors that operate differently in different parts of the country and only for hotels and not other industries that serve travelers such as gas stations and restaurants.

[16] One and two-digit interstate highways (such as I-5, I-75, and I-80) connect cities across multiple states. Odd numbered highways generally run north-south, with route numbers roughly increasing from west (I-5) to east (I-95); even numbered highways generally run east-west with route numbers roughly increasing from south (I-4) to north (I-96). Three-digit highways are part of the system that connect with one- and two-digit highways within metropolitan areas (e.g., "spurs" or "loops"). Because we focus in this analysis on non-urban markets, we do not collect information on three-digit highways. More on the numbering on interstate highways can be found at https://www.fhwa.dot.gov/programadmin/interstate.cfm.

structure—but the highway openings we exploit are mainly in the 1960s and early 1970s.

We calculate from these data the two key independent variables in our analysis. One is $sh(county)_{it}$, the cumulative share of interstate highway mileage in county i that was completed by the end of year t. Because highways are completed and opened in segments, it is typical for only a part of a county's highway mileage to open in a particular year, with the rest of it opening in later years. This variable allows us to assess the effects of highway openings in a county on the number and size of hotels in the same county. Campbell and Hubbard (2016) found that changes in this variable—highway openings within a county—led to changes in industry structure in gas retailing in that county. We will therefore test whether that is the case for hotels as well. Our second key independent variable—the variable that turns out to be more important in our analysis—is $sh(corridor)_{it}$, which is analogous to $sh(county)_{it}$ but calculated at the "corridor" level. The motivation for this variable is that one would expect traffic volumes, and thus potentially demand for hotels, in county i, to be affected not only by highway completion in county i, but also highway completion in other counties on the same route. For example, traffic volumes in Boone County, Missouri—which lies between Kansas City and St. Louis along Interstate 70, should not only be affected by the completion of I-70 in Boone County, but also by the completion of I-70 in other counties between Kansas City and St. Louis. We therefore divide the Interstate Highway System into corridors (such as "Kansas City–St. Louis") and calculate the share of interstate highway mileage completed in the corridor by the end of each year. This gives $sh(corridor)_{it}$ for each county in the corridor.

Although the definition of corridors and construction of $sh(corridor)_{it}$ is discussed at length in the Appendix of Campbell and Hubbard (2016), it is worth discussing in some detail here because it will play a major role in our analysis (in fact, more important than in this earlier paper). The Kansas City-St. Louis example that we describe earlier is one where corridor definition is straightforward; it is less straightforward in other cases.

The first step in defining corridors is determining corridor end points (i.e., the nodes of the network). Because interstate highways were designed to connect large cities, we chose an important interstate highway junction in large metropolitan areas as the exact beginning/end point of a corridor.[17] In some cases, highways do not end in cities (for example, they end at the Canadian border, or an east-west highway ends at the junction with a north-south highway); in these cases, the end of the highway served as the corridor end point. The second step of the process is assigning highway segments to corridors. This is straightforward in cases such as Boone County where the highway is only part of one corridor but is more complicated in other cases, such as when there is a "fork in the road" between two corridor end points, or when highways merge and then separate.[18]

[17] Corridors are typically 150–400 miles long. See Campbell and Hubbard (2016), table A1, for a list of the 115 cities that we designate as corridor end points.

[18] In such cases, the highway segments in the "trunks" are part of multiple corridors that involve different branches. For example, going west from Tucson, Arizona, Interstate 10 splits into two highways (Interstate 8 and the continuation of Interstate 10). The "trunk" between Tucson and this split is part of two

C. *Temperature*

Finally, we collect data on temperatures by county from the North America Land Data Assimilation System (NLDAS).[19] These report average high and low temperatures in each of the counties in our sample, where the averages are taken from 1979–2010 over 14 $\times$ 14 kilometer regions that span each county. From this, we construct an "average temperature" variable for each county by simply taking the mean of the average high and low temperature. Average temperature ranges from about 40 degrees to about 75 degrees across the counties in our sample; the mean across counties is 55 degrees.

D. *Our Sample and Basic Patterns*

We restrict our empirical analysis to smaller counties where traffic patterns are relatively uncomplicated and where one would expect through traffic to be an important source of demand for hotels—and thus, highway completion would be an economically important demand shock. Similar to Campbell and Hubbard (2016), we use only counties with a one- or two-digit interstate highway and no three-digit interstates (which eliminates most large cities and counties where interstates intersect), and further eliminate the few populous counties that remain by dropping those whose total employment exceeded 200,000 in 1992.[20] We also drop counties where the interstate passes through but there is no exit. We conduct our analysis on a balanced panel of 227 counties which satisfy these criteria and for which we observe the number of hotels in each of our sample years.[21]

Figure 7 depicts the counties in our sample, with their average temperatures displayed using a scale ranging from blue to red. This figure shows that our counties come from all regions of the United States. Though none of these counties have large cities, many have smaller cities (e.g., Anniston, Alabama; Modesto, California; New London, Connecticut).

Figure 8 shows county-level employment at hotels in our sample counties. The top panel shows that on average, employment increased from around 300 in 1964 to over 600 in 1992. The bottom panel breaks out the coldest 25 percent and warmest 25 percent of counties in our sample and normalizes employment in each of these two groups to their 1964 level. The trends in these two groups are similar to each other and similar to the average across our sample; total hotel employment slightly more

corridors: Tucson–San Diego and Tucson–Phoenix. For counties along these trunks, we calculate a single corridor completion measure by first calculating the cumulative share of construction along each corridor, then weighting each of these corridors by the traffic volume on each of the branches, evaluated at a point as close as possible to the trunk. For example, if the branch on the Tucson–Phoenix corridor had twice as much traffic as that on the Tucson–San Diego corridor, the former would receive a $2/3$ weight and the latter a $1/3$ weight. Like in Campbell and Hubbard (2016), our traffic counts are averages between 1993–1998, the earliest years for which data are consistently reported. We have not been able to identify traffic data during the 1960s and 1970s.

[19] https://wonder.cdc.gov/nasa-nldas.html.

[20] We do this to eliminate, for example, New York County (i.e., Manhattan), which is one of the rare cases of a large urban county with only one two-digit interstate (I-95) and no three-digit interstates.

[21] The census tended not to publish data for industry counties with fewer than 100 employees during the 1960s and early 1970s, presumably to economize on printing costs. Our balanced panel tends not to include counties with very few hotels (unlike Mazzeo's earlier work).

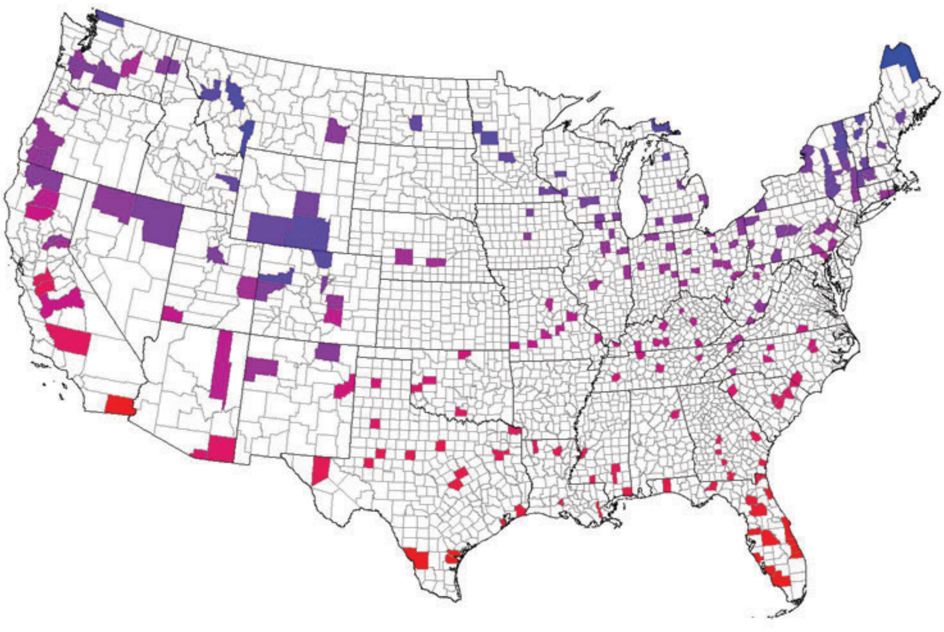

FIGURE 7. SAMPLE COUNTIES

Notes: This map depicts the 227 counties in our sample. Warmer counties are indicated by red; cooler counties are indicated by blue.

than doubled during this time period. This suggests that the magnitude of demand shocks associated with highway construction was not systematically different in the north and south.

Figure 9 shows the average number of hotels in our sample counties. The top panel shows that this declined by 15–20 percent between 1964 and 1981, then rose by the same amount between 1981 and 1992. This pattern is similar to that in the national data we discussed earlier. The bottom panel shows that, unlike the patterns we reported in Figure 8 for employment at hotels, the changes in the number of hotels differ in cold and warm counties. The number of hotels increased during our sample by more than 20 percent in cold counties. It decreased by about 20 percent between 1964 and 1981 in warm counties, then recovered to close to its 1964 level by 1992. Figure 10 reports analogous patterns, normalizing the number of hotels by a county's employment; much of our regression analysis will use this measure. The top panel shows that, on average, the number of hotels per 1,000 county employment declines by about one-half during our sample period; the bottom panel shows that this decline is greater in warm counties than cold counties.

Combined, Figures 8–10 provide evidence that although the supply expansion was similar in cold and warm counties during our sample period, industry structure evolved differently. There was a decline in the number of hotels in our warm counties and an increase in our cold counties.

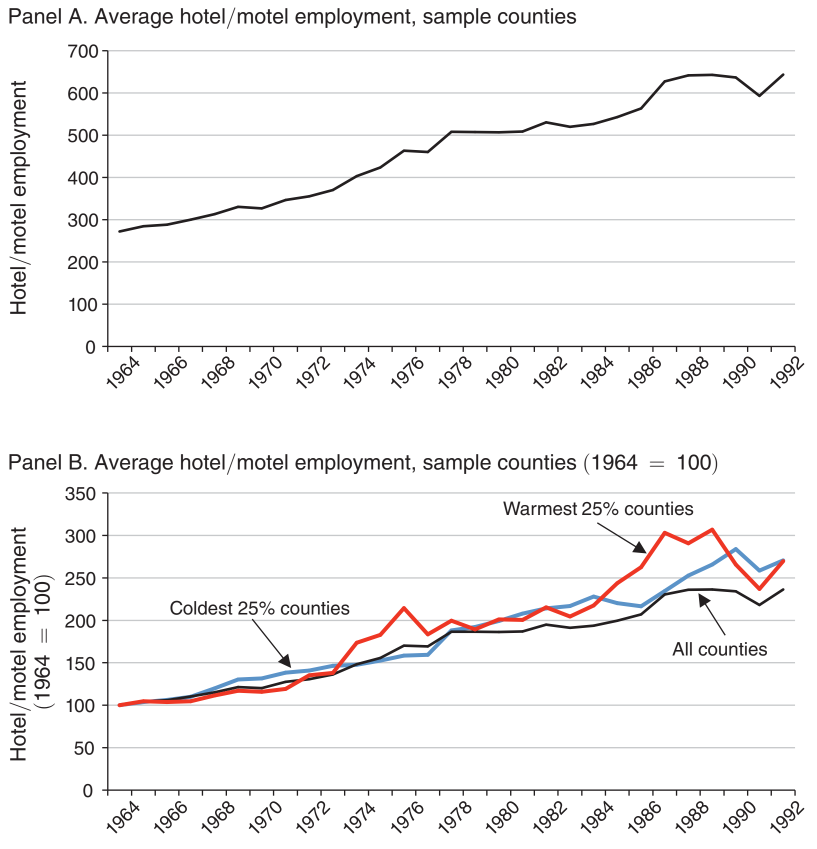

Figure 8. Average Employment, Sample Counties, 1964–1992

Figure 11 depicts interstate highway construction in our sample counties. In the top panel, the dashed line depicts yearly averages of $sh(county)_{it}$. It indicates that, on average, about half of the mileage was completed by the end of 1964, about 80 percent by the end of 1971, and well over 90 percent by the end of 1980. The solid line depicts yearly averages of $sh(corridor)_{it}$, the share of interstate highway mileage in the county's *corridor* that was completed by the end of year t. This shows a similar pattern, but is lower than the dashed line in most of our sample period. Thus, highway construction in our sample counties was generally earlier than construction in the rest of the county's corridor.[22] In the bottom panel, we divide the counties in each year into three categories, according to whether construction is complete, in process, or has not yet begun. This shows that much of the time variation in of $sh(corridor)_{it}$ is accounted for by counties where construction is already complete: thus, when we are measuring the effects of corridor completion on hotels in a county, we are generally picking up the effects of corridor completion in a county where the highway has already

[22] Comparing these figures to those in Figure 6, highways in our sample counties also were completed somewhat earlier than two-digit interstate highways were in general. By the end of 1964, only 35 percent of two-digit interstate highway mileage was completed nationwide, while about 50 percent was completed in our counties.

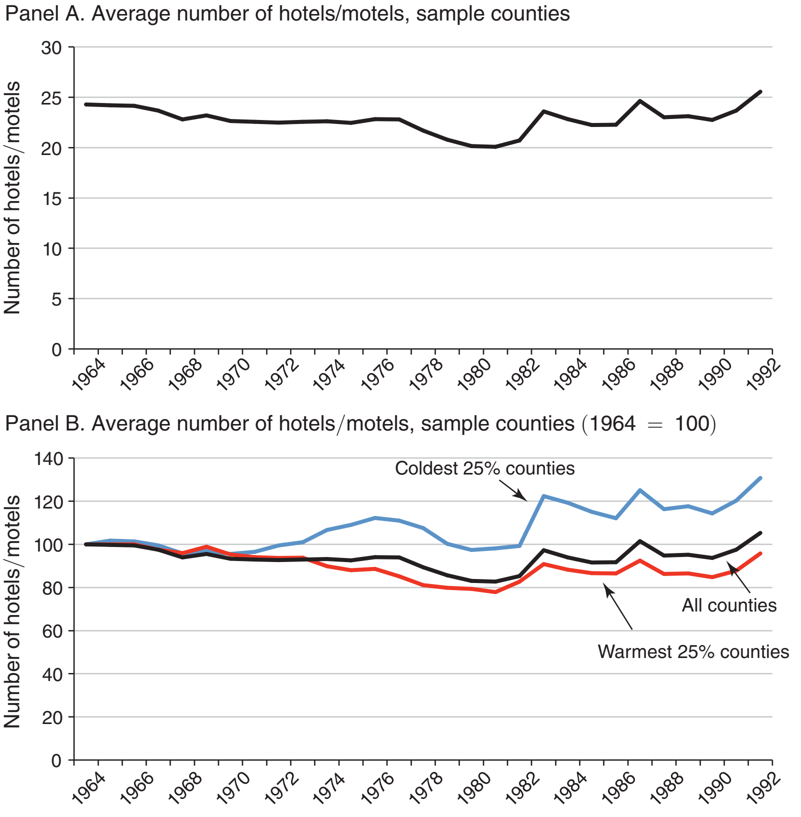

Figure 9. Average Number of Hotels/Motels, Sample Counties, 1964–1992

been finished. We interpret corridor completion as reductions in transportation costs that lead to increases in traffic and therefore demand for hotels; the variation that we are exploiting is, by and large, affecting traffic levels (and hotel demand) in our sample counties by lowering transportation costs through other counties (e.g., neighboring counties on the same corridor).

IV. Empirical Analysis

As described in the introduction, our goal is to investigate the effect of demand shocks on industry structure and to examine the mechanism leading to this effect. The first step in the analysis is to demonstrate that interstate highway openings, in fact, lead to greater demand for hotels in our sample counties. With this in hand, we then relate interstate highway openings to changes in industry structure, and test whether effects differ between warm areas (where the fixed investments associated with swimming pools increase quality more) and in cold areas. We conclude by providing evidence on relationships between interstate highway openings and industry structure in other industries where demand is connected to highway openings but where quality is more difficult to enhance using fixed cost investments—restaurants and gas stations.

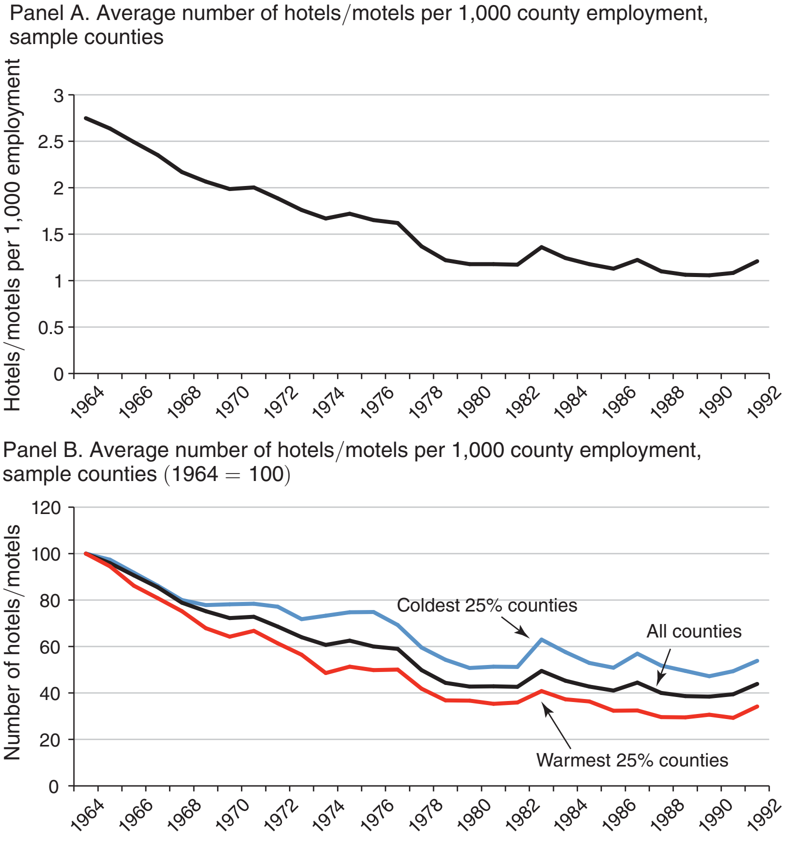

Figure 10. Average Number of Hotels/Motels per 1,000 County Employment, Sample Counties, 1964–1992

A. *Highway Construction and County Hotel Employment*

We begin by presenting results where we relate county hotel employment to highway construction. We use autoregressive specifications that take the form

$$(1) \qquad y_{it} = \alpha_i + \mu_t + \lambda y_{i,t-1} + \beta x_{it} + \varepsilon_{it},$$

where y_{it} is $\ln(\textit{county hotel employment})_{it}$, α_i includes county fixed effects, μ_t includes year fixed effects, and x_{it} includes highway opening variables. Depending on the specification, x_{it} includes $sh(corridor)_{it}$ ("corridor completion") and/or $sh(county)_{it}$ ("county completion"). Without the autoregressive term, the specification boils down to a standard difference-in-difference equation. Including it allows us to capture the basic fact in our data that deviations from the mean across time in a county's hotel employment (or market structure) persist from year to year and lets us estimate our coefficients of interest more efficiently. Our estimates of β give the contemporaneous impact of highway openings on county hotel employment; $\beta/(1-\lambda)$ measures the long-run impact of highway openings on county hotel employment.

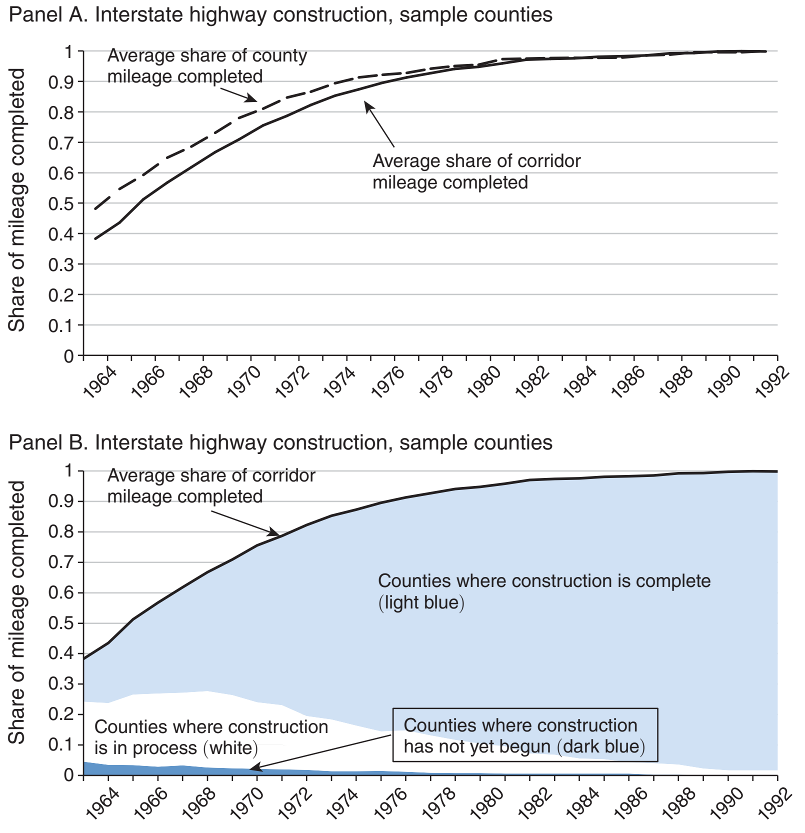

Figure 11. Interstate Highway Construction, Sample Counties

Table 2 reports our results. In the first column, x_{it} includes only corridor completion $(sh(corridor)_{it})$. The coefficient on this variable is positive and significant. Its magnitude indicates that corridor completion is associated with an 8.4 percent contemporaneous increase in county hotel employment. Combined with the estimate on the AR term, it implies that corridor completion is associated with a 29.0 percent long-run increase in county hotel employment. These results are consistent with the hypothesis that highway completion is associated with increases in the demand for hotels in the counties in our sample. Although one effect that the completion of highways may have is to change the distribution of demand from the counties in our sample to larger cities (by increasing travel speeds), this effect appears to be swamped by other effects (e.g., increased traffic volumes) that led to overall increases in demand for hotels in our sample counties.

The second column adds "county completion" $(sh(county)_{it})$ as an independent variable. Our coefficient estimate on this variable is small and statistically insignificant, while our coefficient estimate on "corridor completion" increases slightly. These results indicate that there is no evidence that highway openings in the county at hand have an impact on hotel employment in the county, apart from the fact that such openings increase corridor completion. In other words, what matters is corridor completion, and there is no special effect associated with county completion.

Table 2—Regressions of County Hotel Employment on Corridor and County Highway Openings

Dependent variable: ln(*county hotel employment*)			
sh(*corridor*)	0.084 (0.028)	0.108 (0.035)	
sh(*county*)		−0.029 (0.026)	
sh(*corridor*) × **1**(*corridor construction in county*)			0.090 (0.038)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*no construction yet in county*)			0.214 (0.075)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county partially complete*)			0.077 (0.035)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county fully complete*)			0.095 (0.028)
AR term	0.710 (0.011)	0.710 (0.011)	0.709 (0.011)

Notes: These results are from county-level AR specifications that relate county hotel employment to interstate highway openings. The specifications also include county and year fixed effects (not reported). These results use all counties with non-missing reports for the number of firms/establishments from 1964–1992, $N = 227$. Standard errors are in parentheses; bold indicates that the estimate is statistically significantly different from zero using a test of size 0.05.

Any effects of highway completion on demand for hotels have to do with corridor-level effects (such as increases in traffic volume), not effects associated with changes in traffic patterns in the county at hand.[23]

The third column explores this further by considering the impact of corridor completion on hotel employment in four distinct cases. We first identify cases where at least some of the corridor completion during the year was in the county at hand. We then consider circumstances where corridor completion was entirely outside of the county at hand and distinguish among three cases: one where no construction had yet taken place in the county, another where construction was partially complete in the county (and thus traffic was forced to exit the highway in the county), and a third where construction was fully complete in the county. We then allow the effects of corridor construction to vary across these cases.

The results in this column indicate that corridor construction is associated with increases in county hotel employment in each of these four cases, and there is no evidence that the effects are statistically different. The first case is where corridor completion is in the county at hand: the coefficient is 0.090, which is nearly the same as the average effect across all cases reported in the first column. The second case is counties where no construction yet has taken place. The point estimate on this is much higher—0.214—but the standard error is high as well. The coefficients in the other two cases, counties where construction is partially and fully complete, are similar to that in the first case and the overall average. As noted earlier, and as

[23] This result is different than what Campbell and Hubbard (2016) found for gas stations. There, the effect of highway completion on gas station employment and market structure was associated with completion of the highway in the county rather than the corridor.

indicated by the lower standard errors, cases where construction in the county is fully complete make up the bulk of our sample.

Together, these results are consistent with the hypothesis that demand increases associated with highway completion are related to increased traffic volumes in the corridor, and not other potentially more localized effects. The effect of highway completion in county A on hotel employment in county B (another county on the same corridor) is no different than the effect of highway completion in county B on hotel employment in county B. Furthermore, the effect of highway completion in county A on county B exists both when the highway in county B is fully complete and when it has yet to be started, and the effect is not significantly different.

B. *Highway Completion and Industry Structure in Hotels*

Table 3 begins to show our main results, which relate highway completion to the number and size of hotels in a county. Our specifications are analogous to those in Campbell and Lapham (2004) and Campbell and Hubbard (2016): they are VARs where the dependent variables are the log of the number of hotels in county i in year t (normalized by total county employment in year t) and the log of the average employment size of hotels in county i in year t.[24] These regressions have the same structure as the "county hotel employment" regressions we discuss earlier, but also include the lag of both dependent variables on the right-hand side.

The first column shows the results of our base specification. The top panel shows the relationship between the number of hotels and highway completion. The coefficient on corridor completion is negative and significant: while we know from the previous table that corridor completion is associated with increases in hotel employment in a county (and thus increased demand), these results show that corridor completion is associated with *decreases* in the number of hotels. The coefficient estimates imply that the magnitude of the effects is substantial: completion of a highway corridor that cuts through a county is associated with about a 30 percent decrease in the number of hotels in the long run.

The bottom panel shows the relationship between highway completion and the average employment size of hotels. The coefficient estimate in the first column is positive and significant, and combined with the AR coefficients, indicates that the effect of corridor completion on average hotel size is large—also on the order of 30 percent. Corridor completion, an event that appears to lead to increases in the demand for hotels, is associated with shakeouts in local hotel markets—fewer, but larger, hotels.

The other two columns in this table are analogous to those in Table 2. Like in these other regressions, there is no evidence that these effects differ when corridor completion is in the county at hand, or differ by the extent to which the highway is completed in the county at hand. This fact shapes our interpretation of

[24] As discussed earlier, our dependent variable changes from the number of employer firms operating hotels in county i in year t before 1974 to the number of hotels with positive employment in county i in year t thereafter. We control for the change in our dependent variable between 1973 and 1974 through year fixed effects and by allowing our autoregressive terms to be different in 1974 (to allow the "transition matrix" to be different in this year).

Table 3—Regressions of Number and Size of Hotels on Corridor Completion

Dependent variable: ln(*hotels*/(*county employment* × 1,000))			
sh(*corridor*)	−0.068	−0.048	
	(0.017)	(0.021)	
sh(*county*)		−0.024	
		(0.015)	
sh(*corridor*) × **1**(*corridor construction in county*)			−0.067
			(0.023)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*no construction yet in county*)			−0.043
			(0.045)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county partially complete*)			−0.084
			(0.021)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county fully complete*)			−0.064
			(0.017)
AR term	0.774	0.772	0.774
	(0.011)	(0.011)	(0.011)
Dependent variable: ln(*employment*/*hotel*)			
sh(*corridor*)	0.112	0.113	
	(0.028)	(0.035)	
sh(*county*)		−0.002	
		(0.026)	
sh(*corridor*) × **1**(*corridor construction in county*)			0.110
			(0.038)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*no construction yet in county*)			0.186
			(0.074)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county partially complete*)			0.101
			(0.034)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county fully complete*)			0.118
			(0.029)
AR term	0.631	0.631	0.630
	(0.013)	(0.013)	(0.013)

Notes: "Hotels" are census-reporting units. Before 1974, this equals the number of firms (with positive employment) operating hotels in the county. Starting in 1973, this equals the number of hotels (with positive employment). The specifications also include county and year fixed effects (not reported). We also allow the autoregressive coefficients to differ in year 1974 to accommodate the census' change in reporting units between 1973 and 1974. These results use all counties with non-missing reports for the number of firms/establishments from 1964–1992, $N = 227$. Standard errors are in parentheses.

the relationship between highway completion and shakeouts. If our results only reflected that highway completion in county A led to a decline in the number of hotels in county A, then shakeouts associated with highway completion could reflect the impact that new highways have on industry structure through changes in local traffic patterns: for example, they could change local markets' competitive dynamics, decreasing local geographic differentiation by making hotel locations near exits more desirable than other locations. However, we find that the effect of highway completion in county A leads to a similar decline in the number of hotels in county A and in other counties along the same corridor—including counties where the highway was completed years before. We therefore conclude that the relationship between highway completion and shakeouts is instead related to highway completion's effect on traffic levels and thus demand for lodging in

Table 4—Regressions of Number of Hotels by Size Category on Corridor Highway Openings (By Status of Construction in the County)

Dependent variable	Very small hotels	Small hotels	Medium hotels	Large hotels	Very small hotels	Small hotels	Medium hotels	Large hotels
AR term	0.744	0.444	0.510	0.734	0.744	0.443	0.508	0.733
	(0.008)	(0.011)	(0.011)	(0.009)	(0.008)	(0.011)	(0.011)	(0.009)
sh(*corridor*)	−0.812	−0.063	0.169	0.568				
	(0.272)	(0.153)	(0.147)	(0.135)				
sh(*corridor*) × **1**(*corridor construction in county*)					−1.029	0.213	0.074	0.643
					(0.365)	(0.205)	(0.197)	(0.181)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*no construction yet in county*)					−1.518	0.442	0.378	1.041
					(0.681)	(0.383)	(0.369)	(0.339)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county partially complete*)					−0.805	0.057	0.023	0.724
					(0.334)	(0.188)	(0.181)	(0.167)
sh(*corridor*) × **1**(*all corridor construction out of county*) × **1**(*county fully complete*)					−0.870	−0.030	0.195	0.592
					(0.276)	(0.155)	(0.149)	(0.137)

Notes: These results are from county-level VAR specifications that relate the number of hotels in different size categories to interstate highway openings. The specifications also include county and year fixed effects (not reported). These results use all counties with non-missing reports for the number of firms/establishments from 1964–1992, $N = 226$. Standard errors are in parentheses. Very small hotels indicate 1–3 employees (before 1974) and 1–4 employees (1974 on). Small hotels indicate 4–7 employees (before 1974) and 5–9 employees (1974 on). Medium hotels indicate 8–19 employees (before 1974) and 10–19 employees (1974 on). Large hotels indicate 20 or more employees.

the county—an effect that would exist regardless of whether the highway was completed in the county at hand or in other counties on the same corridor.

Table 4 provides further detail. The CBP reports the number of hotels in various employment-size categories; we collapse these into four: very small hotels (1–3 employees), small hotels (4–7 employees), medium hotels (8–19 employees), and large hotels (at least 20 employees).[25] We then run vector autoregressive specifications, using the number of hotels in these categories as the four dependent variables. The left side of Table 4 contains our base specification. The coefficient estimates indicate that the corridor completion is associated with a decrease in the number of very small hotels (slightly more than three hotels, on average) and an increase in the number of very large hotels (slightly more than two, on average). The decrease in the number of "very small" hotels is highly likely to understate the shakeout of small enterprises because this analysis omits hotels with no employees—which we show earlier to be a non-negligible share of the market at the beginning of our time period. Given that highway completion is associated with a shakeout of hotels with 1–3 employees, it is highly likely that it is also associated with a shake-out of hotels with no employees (those owned and run, for example, by a husband and wife team) as well.

The right side of the table allows the coefficient on corridor completion to differ across the four cases described earlier. As before, there is no evidence that the

[25] These categories change slightly starting in 1974; see the notes to Table 4.

coefficients differ: the number of small hotels decreases, and the number of large hotels increases, irrespective of whether the corridor completion was in the county at hand, and irrespective of how much of the highway in the county at hand had been completed.

C. *Non-price Competition and Shakeouts: Is the Shakeout Greater in Warmer Places?*

Summarizing, Tables 2–4 show some central empirical facts: the completion of highways leads hotel employment to increase and leads to fewer but larger firms. The following subsections provide evidence on how these results reflect non-price competition in this industry.

Our analytical framework showed that, in a homogeneous good industry, increases in demand should not lead to shakeouts: the number of firms should (weakly) increase, not decrease. In a differentiated product market, however, firms' competitive responses to positive demand shocks can lead the equilibrium number of firms to decrease. In particular, if there is vertical differentiation and quality is produced with fixed costs, then demand increases can lead to the emergence of scale-intensive high-quality firms that can price low enough not only to attract customers with a high willingness to pay for quality, but also those with a lower willingness to pay for quality. This competitive response, in turn, can lead to the shakeout of smaller, low-quality firms and to a net decrease in the total number of firms.

Our discussion earlier described how one quality amenity that was becoming increasingly prevalent at US hotels during our time period was a swimming pool. Supplying this amenity involved almost entirely fixed costs—the cost of supplying this amenity was the same, irrespective of how many guests would ultimately utilize it. However, the quality enhancement associated with this investment varied with the local climate—it was higher in warmer places because the pool was usable more months out of the year. If the shakeout associated with highway completion reflected non-price competition associated with swimming pools (or other less common outdoor amenities such as a playground or putting green), one would expect the shakeout to be greater in warmer places.

We test this proposition in Table 5 by interacting corridor completion with the average temperature in each of our sample counties.[26] The top panel shows regressions where the dependent variable is (logged) county hotel employment, the number of hotels (normalized by county employment), and the average employment size of hotels. The interaction coefficient in the first column is essentially zero: the relationship between corridor completion and county hotel employment is just as strong in cold places as in warmer places. There is thus no evidence that highway completion leads to larger increases in demand for hotels in the warm counties in our sample than the cold counties in our sample. The coefficients in the second and third columns show that the change in industry structure is very different. The interaction

[26] More precisely, we interact it with (temperature = 55) so that the un-interacted coefficient corresponds to the effect of highway completion for the county in our sample with average temperature.

Table 5—Interaction Effects with Temperature: Hotels

Dependent variable	ln(*county hotel employment*)	ln(*hotels*/(*county emp.* × 1,000))	ln(*employees*/*hotel*)	
sh(*corridor*)	0.079	−0.048	0.089	
	(0.029)	(0.017)	(0.029)	
sh(*corridor*) × *temperature*	0.001	−0.005	0.004	
	(0.002)	(0.001)	(0.002)	
Dependent variable	Very small hotels	Small hotels	Medium hotels	Large hotels
sh(*corridor*)	−0.551	0.030	0.301	0.334
	(0.281)	(0.159)	(0.152)	(0.139)
sh(*corridor*) × *temperature*	−0.060	−0.021	−0.030	0.054
	(0.017)	(0.010)	(0.009)	(0.008)

Notes: "Hotels" are census-reporting units. Before 1974, this equals the number of firms (with positive employment) operating hotels in the county. Starting in 1974, this equals the number of hotels (with positive employment). The specifications also include county and year fixed effects (not reported). We also allow the autoregressive coefficients to differ in year 1974 to accommodate the census' change in reporting units between 1973 and 1974. These results use all counties with non-missing reports for the number of firms/establishments from 1964–1992, $N = 227$. Standard errors are in parentheses. Very small hotels indicate 1–3 employees (before 1974) and 1–4 employees (1974 on). Small hotels indicate 4–7 employees (before 1974) and 5–9 employees (1974 on). Medium hotels indicate 8–19 employees (before 1974) and 10–19 employees (1974 on). Large hotels indicate 20 or more employees.

coefficient in the second column is negative, significant, and economically large. It implies that the shakeout associated with highway completion was much greater in warmer places. The magnitudes imply essentially no change in the number of hotels in our cooler counties (counties with an average temperature around 45 degrees), but a large decrease—twice the average effect—in our warmer counties (counties with an average temperature of around 65 degrees). The interaction coefficient in the right column suggests that the increase in hotel size was also more pronounced in warmer counties than cooler counties, though the coefficient is not quite statistically different from zero using a test of size 0.05.

We show these results graphically in Figure 12. The top panel shows the relationship between corridor completion and county hotel employment. The long-run effect is more than 20 percent, and is not statistically different for cold and warm counties; if anything, the effect is larger for warmer counties. The bottom panel shows the relationship between corridor completion and the number of hotels. There is no effect in cold counties, but a large effect—on the order of a 40 percent decrease—in warm counties.

The bottom panel of Table 5 shows interaction specifications where the dependent variable is the number of hotels in different employment-size categories. These results are similar to those in the top panel and imply that the decrease in very small hotels, and increase in large hotels, was much greater in our warmer counties than in our cooler counties. Figure 13 shows this graphically. In warm counties, there is an increase in the number of large hotels and a correspondingly larger decrease in the number of small hotels. In contrast, in cold counties, corridor completion has little effect on the number of hotels in any of these size categories. In particular, we find no evidence that corridor completion leads to more

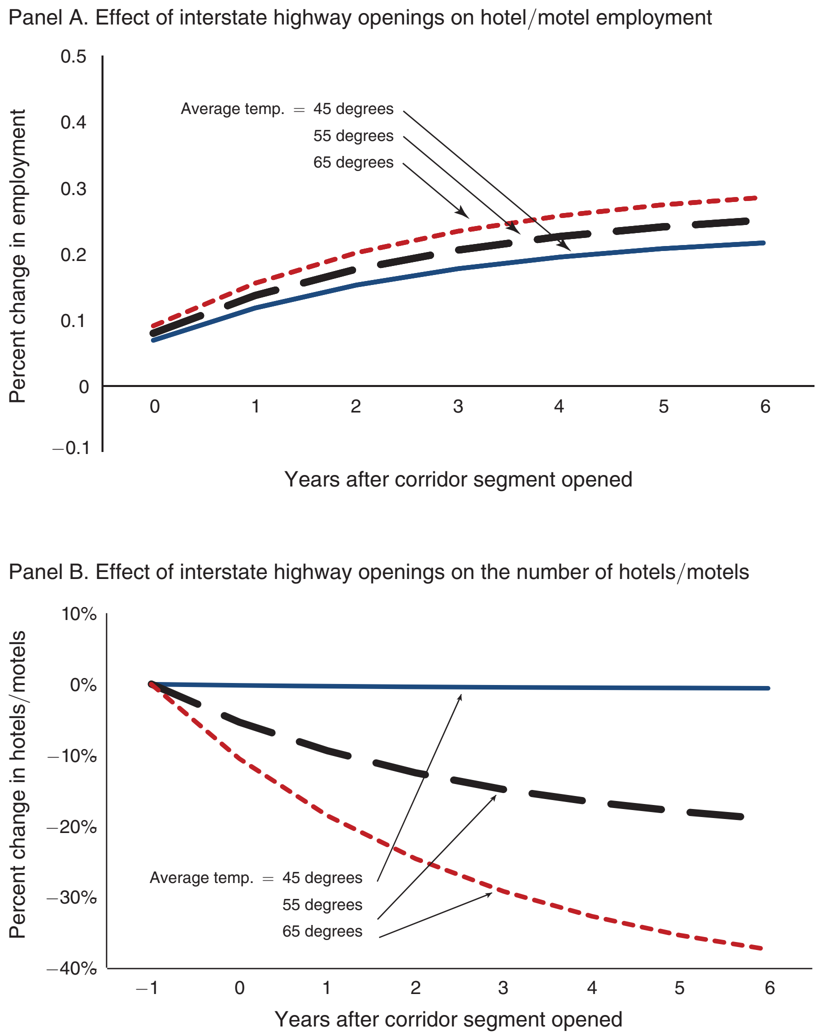

Figure 12. Interstate Highways Lead to Fewer Hotels/Motels in Warm Counties, but Not Cold Counties

large hotels, or to a shakeout of very small hotels. The adjustment in industry structure was very different in warm places than cold places.

Together, these results provide support for the proposition that non-price competition in the form of fixed costs explains why highway completion led to a shakeout in the number of hotels. Our evidence indicates that highway completion led to increases in the demand for hotels in both cool and warm counties in our sample—in both North Dakota and Georgia. But it led to fewer, but larger, hotels only in the warm places, but not the cold places.

Earlier in this paper, we emphasize one form of quality competition that would lead to shakeouts in the south but not in the north: investments in outdoor amenities. However, quality competition in the form of other fixed costs could, in principle, explain the patterns in our regression results as well. While it is quite reasonable to suspect that customers would enjoy swimming in a warmer climate, it could also

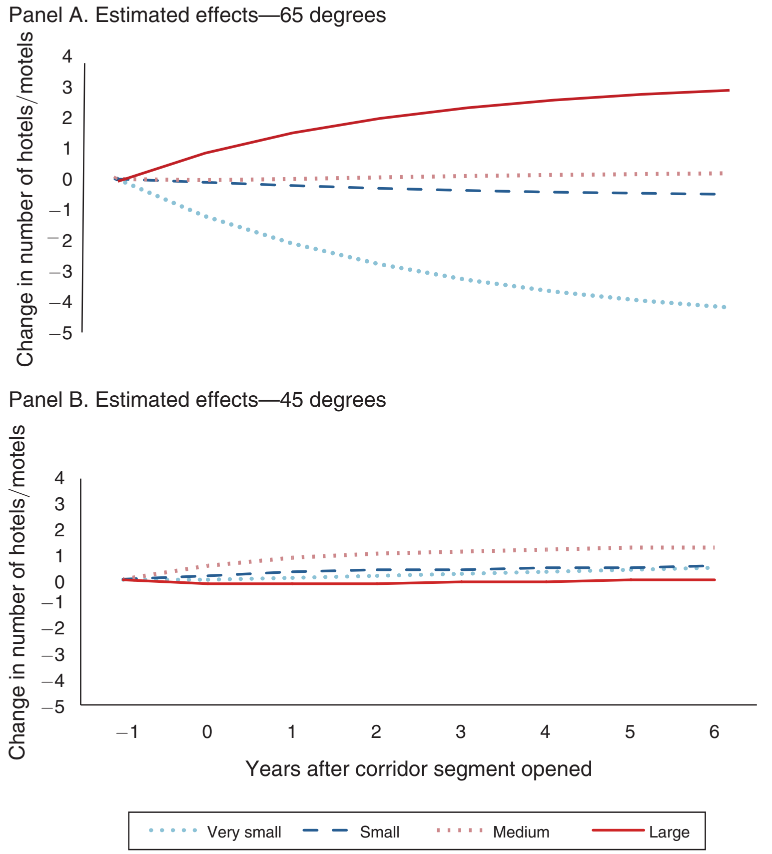

Figure 13. Effect of Highway Completion on Number of Hotels/Motels by Size Category, Temperature

be the case that for some reason customers in warmer places are more brand-sensitive than customers in cooler places. Then increases in quality competition in the form of investments in advertising or branding could lead to shakeouts, particularly in warmer places. The fact that motel chains are more prevalent in warmer places during our sample period is consistent with the hypothesis that customers' valuation of brands or perhaps consistency differs across regions. However, it is unlikely that increases in quality competition associated with investments that are particular to chains explain our results. If they did, one would expect that such competition would lead chains' share of revenues to increase more during this period in warmer than colder places. As we discuss earlier and illustrate in Figure 5, this was not the case: the increase in chains' share of revenues was very similar in warmer and colder places. We therefore conclude that an increase in non-price competition in the form of outdoor amenities, especially swimming pools, is a more likely explanation for the patterns that we uncover.

We have further tested whether our results could reflect differences in customers in warmer and cooler places, rather than differences in firms' incentives in these places, by examining testing whether they differ between highways that are oriented east-west and north-south. On north-south highways, through traffic in cool and warm counties is likely to consist of the same customers, traveling through both. In contrast, through traffic on east-west highways is likely to consist of different customers, depending on whether the highway is in the north (cooler counties) or south (warmer counties). We have run our specifications allowing our coefficients to differ, depending on whether the highway runs north-south (i.e., an odd-numbered highway) or east-west (i.e., an even-numbered highway). We found that our results are stronger for the north-south highways than the east-west highways. This provides additional evidence that our results reflect differences in firms' competitive incentives in cool and warm places, not differences in customers.[27]

D. *Non-price Competition: Do These Patterns Appear for Restaurants and Gas Stations?*

Finally, we show results from analogous specifications that investigate relationships between highway completion and our main variables for two other industries: restaurants and gas retailing. As discussed in Berry and Waldfogel (2010), one would expect non-price competition in the form of fixed costs to be more limited in the case of restaurants because quality tends to be supplied in the form of higher variable costs (for example, in better ingredients and/or higher levels of service). Similarly, quality competition among gas stations during the time of our sample—a time when full service was still common and gas stations did not have convenience stores attached—generally involved variable costs (e.g., more attendants) rather than fixed costs. Therefore, even though highway completion likely also increased local demand for restaurants and gas retailers, one would expect any changes in industry structure to be different. In particular, highway completion should not lead to shakeouts in these industries.

Tables 6 and 7 summarizes our results for these two industries. Table 6 shows them for "eating and drinking places" ("EDPs").[28] The first column shows that corridor completion is associated with increases in restaurant employment, consistent with the proposition that it led to demand increases for restaurants in our sample, and that the effect is greater in warmer counties. In the second column, the dependent variable is the (normalized) number of EDPs. Unlike for hotels, we find no evidence of a relationship between corridor completion and the number of restaurants, and in particular no evidence of a shakeout. Table 7 provides analogous estimates for gas stations.[29] The first column shows a positive and significant relationship between employment and corridor completion, but no evidence that this varies with county temperature. In the second column, where the dependent variable is the number of gas stations, the coefficients are small and not statistically significant.

[27] This also suggests that the expansion in demand that is relevant here is expansion in leisure travel, rather than business travel. Regardless, our interpretation of our main results is unchanged. Even if the expansion on north-south highways is entirely in leisure travel, our results indicate that it was associated with shakeouts in warmer places, and not cooler places.

[28] This is SIC code 58, "eating and drinking places." It includes restaurants (including limited service restaurants such as McDonald's), cafeterias, and bars.

[29] This is SIC code 554, "gasoline retailing."

Table 6—Interaction Effects with Temperature: Eating and Drinking Places

Dependent variable	ln(*county EDP employment*)	ln(*EDPs*/(*county emp.* × 1,000))	ln(*employees*/*EDP*)	
sh(*corridor*)	0.035 (0.012)	−0.001 (0.009)	0.003 (0.011)	
sh(*corridor*) × *temperature*	0.004 (0.001)	0.000 (0.001)	0.001 (0.001)	
Dependent variable	Very small EDPs	Small EDPs	Medium EDPs	Large EDPs
sh(*corridor*)	−0.355 (0.820)	0.880 (0.519)	0.329 (0.478)	−0.188 (0.458)
sh(*corridor*) × *temperature*	0.047 (0.049)	−0.017 (0.031)	0.120 (0.029)	0.057 (0.027)

Notes: "EDPs" are census-reporting units. Before 1974, this equals the number of firms (with positive employment) operating restaurants or bars in the county. Starting in 1974, this equals the number of restaurants and bars (with positive employment). The specifications also include county and year fixed effects (not reported). We also allow the autoregressive coefficients to differ in year 1974 to accommodate the census' change in reporting units between 1973 and 1974. These results use all counties with non-missing reports for the number of firms/establishments from 1964–1992, $N = 226$. Standard errors are in parentheses. Very small EDPs indicate 1–3 employees (before 1974) and 1–4 employees (1974 on). Small EDPs indicate 4–7 employees (before 1974) and 5–9 employees (1974 on). Medium EDPs indicate 8–19 employees (before 1974) and 10–19 employees (1974 on). Large EDPs indicate 20 or more employees.

Table 7—Interaction Effects with Temperature: Gas Stations

Dependent variable	ln(*county gas employment*)	ln(*gas stations*/(*county emp.* × 1,000))	ln(*employees*/*gas station*)	
sh(*corridor*)	0.031 (0.015)	−0.009 (0.011)	0.012 (0.014)	
sh(*corridor*) × *temperature*	0.000 (0.001)	−0.001 (0.001)	−0.002 (0.001)	
Dependent variable	Very small stations	Small stations	Medium stations	Large stations
sh(*corridor*)	1.001 (0.581)	−0.235 (0.428)	0.636 (0.253)	−0.001 (0.106)
sh(*corridor*) × *temperature*	−0.093 (0.033)	−0.034 (0.024)	0.020 (0.015)	−0.003 (0.006)

Notes: "Gas stations" are census-reporting units. Before 1974, this equals the number of firms (with positive employment) operating gas stations in the county. Starting in 1974, this equals the number of gas stations (with positive employment). The specifications also include county and year fixed effects (not reported). We also allow the autoregressive coefficients to differ in year 1974 to accommodate the census' change in reporting units between 1973 and 1974. These results use all counties with non-missing reports for the number of firms/establishments (for hotels) from 1964–1992, $N = 227$. Standard errors are in parentheses. Very small stations indicate 1–3 employees (before 1974) and 1–4 employees (1974 on). Small stations indicate 4–7 employees (before 1974) and 5–9 employees (1974 on). Medium stations indicate 8–19 employees (before 1974) and 10–19 employees (1974 on). Large stations indicate 20 or more employees.

Figure 14 summarizes our cross-industry comparison; on average, corridor completion is associated with a large decline in the number of hotels, but little if any change in the number of restaurants or gas stations. Consistent with the proposition that the shakeouts we document in hotels are associated with non-price competition

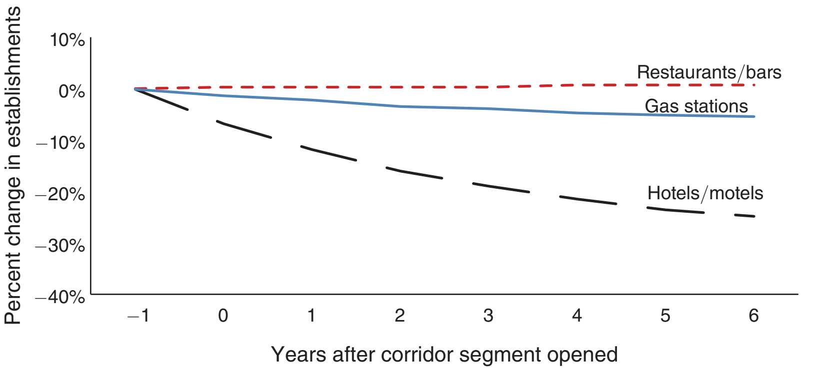

Figure 14. Effect of Interstate Highway Openings on the Number of Hotels/Motels, Gas Stations, and Restaurants/Bars

in the form of fixed costs, we do not see similar shakeouts in other industries where highway completion led to demand increases, but where non-price competition in the form in fixed costs is muted.

E. *Increases in Non-price Competition: Evidence from American Automobile Association (AAA) Tour Books*

We obtained further evidence on hotels and motels in our sample counties by acquiring AAA hotel guides for as many states as possible in the years 1965 and 1982, dates early and late in our sample period. AAA published hotel guides that cover individual states, or groups of states; we were able to obtain guides that include 176 of our 227 counties in 1965 and 128 of our 227 counties in 1982. An advantage of the AAA guides is that they describe amenities of the hotels that are included, including whether the hotel has a swimming pool. A disadvantage of the AAA guides is that they cover a subset of hotels and motels: about one-third in our sample counties in 1965 and about 40 percent in 1982. AAA maintains minimum quality standards for inclusion; therefore, these tend to be higher quality hotels than hotels that are not covered in these guides.

We examined how the share of AAA-covered hotels with pools changed over time and how this change differed in warm places versus cold places. We found that this share increased from 29 percent to 49 percent between 1965 and 1982 among the sample counties in the US's coldest quartile of states and from 73 percent to 90 percent among those in the US's warmest quartile of states. Thus, among AAA-covered hotels, the increase during our sample period was slightly greater in the coldest states than in the warmest states. In contrast, Figure 4 showed the opposite was true when looking at all hotels, not just AAA-covered hotels; the increase between 1963 and 1972 (the latest the census surveyed hotels about amenities) was greater in warmer states than colder states. Combined, the evidence suggests that the key pattern in Figure 4—the greater increase in the share of hotels and motels with a pool in warm places—largely reflects increases in this share among hotels and motels that are *not* covered by AAA, not those that are.

As a consequence, any differential increase in quality competition between warmer and colder counties in our sample is unlikely to reflect differences in competition at the highest end of the market, but rather differences in competition among somewhat lower quality (i.e., non-AAA covered) hotels. This is inconvenient from a research perspective, since this segment is not as well-documented as the high end of the market, which is reasonably covered by travel guides. However, it is helpful in explaining the shakeouts that we observe in the overall data. Our evidence indicated that very small—and probably low-quality—hotels were shaken out as highways were completed. One would expect this if non-price competition was becoming more intense in adjacent segments (i.e., somewhat higher quality hotels), but not as much if non-price competition was increasing among more distant competitors.

V. Conclusion

Economists and policymakers are interested in understanding both the causes and the consequences of concentrated industry structure. The appropriate response to industry consolidation is likely to be different if it is precipitated by natural economic factors—firms optimally responding to competitive pressures and exogenous market changes—as opposed to clear anticompetitive motives. Indeed, theoretical models provide various explanations for why industry shakeouts may occur naturally.

In this paper, we have explored an explanation highlighted in Sutton (1991): that in certain circumstances, demand *increases* can catalyze shakeouts by initiating changes in an industry's competitive dynamics. In industries where product quality affects customer preferences—and in which investments in fixed costs are required for firms to increase their quality—consolidation may be precipitated by market size increases. Firms initially provide low quality when market size is small because there is not enough demand to offset the fixed cost investment. But as market size increases, one or more of the competitors will find it attractive to invest, and their subsequent quality increase will shift market share their way. If enough share shifts from the low-quality competitors, they may be forced to exit, resulting in an industry shakeout.

We document an occurrence of this phenomenon using data on non-urban hotels and motels in the second half of the twentieth century. During this period, consumer demand for lodging increased substantially but the number of hotels and motels did not. We examine a dataset consisting of counties through which an interstate highway passes. We take advantage of variation in the timing of when highways were completed to establish when demand increases happened in our counties. Demand is enhanced in a county when the highway is completed not only within the county itself, but also within other counties along the same highway corridor.

Our empirical analysis shows that the number of hotels and motels decreases in these counties when highways are completed; demand increases are associated with shakeouts. Our hypothesis is that market size increases allow more hotels and motels to profitably invest in swimming pools for their properties, and when that fixed cost investment increases quality for consumers, consolidation ensues.

Evidence consistent with our hypothesis comes from comparing geographic markets that have cold climates with ones that are warmer—the post-demand consolidation happens only in counties where the weather is warm. We find no evidence that demand increases precipitate shakeouts in colder markets, where investments in swimming pools (or other outdoor amenities) do not increase consumers' willingness to pay as much. We also find no evidence that demand increases associated with highway openings lead to shakeouts of restaurants or gas stations, where quality enhancements are less likely to be produced through fixed costs.

While we are only able to investigate this competitive explanation for industry consolidation in a narrowly defined industry over a particular time period, we believe that the mechanism through which increases in market size can lead to shakeouts—increases in firms' incentives to engage in scale-intensive quality competition—is more general due to its close connection with the underlying theoretical result. Here, we take advantage of the unique features of highway construction to document discrete variation in the timing of demand increases; highway construction provides for an observable demand shock to certain industries, including the ones that we study here. Finding analogous observable demand shocks is always a challenge for dynamic industry structure studies and will need to be addressed in order to investigate this phenomenon elsewhere. Finally, it is worth noting that while the explanation for the shakeouts described here revolves around enhanced competitive incentives rather than other, less benign explanations, we offer no conclusions about the welfare consequences of the effects we study, even in the context that we examine. The remaining industry participants may charge higher prices, but consumers appear to appreciate these higher quality offerings.

In closing, we emphasize an important normative implication of Sutton (1991) that our study illuminates: distinguishing between "competition-driven" versus "market-power-driven" increases in concentration is difficult and requires (at the very least) an assessment of whether increases in concentration are due to changes in firms' incentives to compete on quality dimensions. Furthermore, policies that attempt to stem increases in concentration that are due to changes in firms' incentives to compete on these dimensions run the risk of reducing rather than increasing competition. In cases where increases in concentration are a manifestation of a strengthening of firms' competitive incentives (some of which may not show up in the form of lower price-cost margins), it is far from clear that preventing such increases should be a goal of competition policy.

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