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Buy Here, or Keep Driving? The Effect of Geographic Market Density on Retail Gas Prices

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ABSTRACT

This paper examines whether the presence of local competitors affects the retail price of gasoline in mid-sized American cities. Spatial regression analysis permits an answer that is clear of potentially confounding statistical problems. Results continue to show small impacts of local competition, especially compared to other factors.

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1.0 Introduction

Gasoline prices command the attention of consumers, competitors, and legislators on a daily basis. The constant fluctuation seems to motivate consumers to drive across town to save a few cents per gallon. While prices may differ even between stations located at the same intersection, the question remains whether competition actually affects the retail price of gasoline. Does the spatial distribution and concentration of stations significantly impact gas prices? The effect of competition among neighboring retail stations upon the price of gasoline has been sparsely explored by previous studies: only in specific cities or time periods, and it is unclear that the results are clear of spatial correlation biases. While previous studies have outlined many factors, both demand-side and supply-side, that contribute to price differences, it remains unclear whether we have a definitive answer to whether more gas stations in a local market act on prices the way that theory indicates they should. This study uses spatial econometric analysis to evaluate the impact of local competition on retail gasoline prices, controlling for brand effects and other obvious factors across a range of cities.

To establish the impact of competition, we examine the factors which influence the retail price of gasoline in seven midsized-US-metro areas: Bakersfield, CA; Colorado Springs, CO; Pittsburgh, PA; Raleigh, NC; Toledo, OH; Tulsa, OK; and Wichita, KS. We collected data in the summers of 2009 and 2010 on retail prices, fuel grade, retailer brand and geographic concentration. We utilize various measures of spatial concentration, ranging from a simple count of the number of stations within a tenth of mile radius to the number of stations within one mile of each gas station, as well as a nonlinear Hirschman-Herfindahl type measure.

Section 2 of this paper reviews the relevant literature on the gasoline market, as well as different methods of measuring spatial competition in the gas market and other consumer markets. Section 3 describes our data set, designed for compatibility with the literature. Section 4 explains the calculations and analysis performed on the gasoline data. Section 5 presents the results of the regression analyses. Section 6 concludes with implications for policy and future research.

2.0 Literature review

Given the importance of gasoline in today's economy, there is an abundance of literature devoted to the study of retail gasoline pricing. Studies as early as Livingston and Levitt (1959) found a distinct difference in gasoline prices depending on the type of retail outlet; larger national outlets associated with specific refineries versus smaller independent local businesses that purchased their gas at the lowest price possible. Marvel (1976) found that higher-priced gas stations (typically branded, in a contractual arrangement with a specific refiner) showed smaller price fluctuation, a distinction continued by the work of Barron and Umbeck (1984), Comonor and Riddle (2003) and a result confirmed by Deck and Wilson (2008). The Federal Trade Commission (2005) confirms that increased competition leads to lower gas prices, but only at a marginal level. Deltas (2007) confirmed the presence of local market power, and determined that gasoline stations adjust their prices quicker in response to a wholesale price increase than to an equivalent wholesale price decrease. However, none of these studies explicitly model spatial competition.

Greenhut and Greenhut (1975) make assumptions typically associated with spatial price discrimination, but do not test those assumptions outside of a model framework. Hastings (2000) examined local price changes during a natural experiment, when an independent (Thrifty) station became a vertically integrated (ARCO) station in the San Diego and Los Angeles metropolitan areas; she found quite clearly that the replacement of an independent station with a branded station led to prices five cents above market price for all gas stations within one mile of one another. Within cities, she found small regions where gas stations appeared to be competing on price. Meyer and Fischer (2004) investigated price zones and territorial restrictions by larger refiners and found that their removal would lead to higher average prices in many areas, that both price zones and territorial restrictions can promote efficiency and competition within the gasoline market. Those conclusions were echoed by Deck and Wilson (2008).

Price dispersion within metropolitan areas has been investigated elsewhere (e.g. Pinske, Slade, and Brett, 2002; Barron, Taylor, and Umbeck, 2004; Barron, Umbeck, and Waddell, 2008) and those studies consistently find small but reproducible impacts: a larger number of competitors cause the price of gasoline to fall. However, it is unclear that they fully corrected for spatial statistical concerns that may have compromised their results. In contrast, Davis (2006) investigated the impact of spatial competition on movie theaters, measuring competitive distance in Euclidean space. We intend to emulate these approaches with a nationally-representative sample of cities for comparison, and the best statistical techniques available in order to avoid any previous biases.

3.0 Data

This study focuses on retail gasoline prices for mid-sized U.S. cities which constitute their own market, so were chosen for their similar population sizes (250,000 to 450,000) and non-proximity to another urban center. Of the 29 cities in the United States with a population between 250,000 to 450,000 residents[1], ten cities were rejected for analysis because they represent twins of other large cities (e.g. St. Paul, MN; Tampa, FL) or suburbs of even larger cities (e.g. Aurora, CO; Arlington, TX), such that they do not constitute distinct markets. Of the 13 cities isolated enough to present a distinct market, six were removed from consideration as they are distinguished as the only sizable city within the entire state or region. Therefore, there are six cities considered in the analysis here: Bakersfield, CA; Colorado Springs, CO; Pittsburgh, PA; Raleigh, NC; Tulsa, OK; and Wichita, KS. Each is treated separately to see if the same model applies.

For each of the six of the cities selected, retail gas prices were collected between June 19, 2009 and July 2, 2009 for regular, premium, and diesel gasoline. While these data are now historical, they were chosen based on availability at the time of research, and there is little obvious reason to believe that the competitive structure of the industry has changed markedly in the intervening years. During this period, the U.S. national average retail price for regular grade gasoline was $2.65/gallon (EIA, 2009). Prices were collected from two user-maintained online resources, gasbuddy.com and gaspricewatch.com, for all observations within those metropolitan centers over the observation period. The resulting data represent at least one observation per station, but frequently multiple observations across multiple days. For each station, data were recorded for retail prices of each available fuel grade, the station address and the gasoline brand.

We recognize that the data that is provided for these six cities by these websites does not necessarily include all stations within a city, or even a given intersection. Further, as user-maintained websites, postings may not represent a random sample of prices within a given area, as users may be prone to report exceptionally high or low prices to inform other system users. Moreover, the data may suffer from reporting bias if users are inaccurate in their postings to the service.

In order to consider the importance of these biases, we collected supplementary data from the universe of all gas stations in the city of Colorado Springs, CO during a control period outside of the observation period, almost precisely one year later on July 17-July 18, 2010, when the U.S. national average retail price for regular grade gasoline was an almost identical $2.69/gallon (EIA, 2009). This dataset was compiled from two sources: OPIS (a national source of gas prices that uses credit card purchases to track gas prices for U.S. cities), and direct telephone calls to every remaining gas station to inquire about current prices. We complemented these control observations with the corresponding Colorado Springs gas price data from gasbuddy.com and gaspricewatch.com over the same 2010 period. In order to test whether our "online user-provided data" sample is drawn from the same distribution as the complete set of gas stations, we calculated the Kolmogorov-Smirnov D statistic for our Colorado Springs sample. The resulting value of 0.0691 indicates 99% certitude that our 2009 sample is drawn from the same distribution as the population of stations not represented in our sample.

In order to determine proximity, we geo-coded the address of each gas station to a precise latitude and longitude. With this information, we computed the pair-wise distances (in feet) between every station within each city. The resulting sample represents 5009 observations across 786 separate gas stations (an average of 6.4 price observations per station). As it is unclear what specific distance might be relevant to consumer purchase or producer location decisions, we calculated several alternative measures of spatial concentration in order to run sensitivity tests on different definitions. Following Davis (2006), we calculated the following measures for each station, and therefore for each gas price observation: distance to nearest competitor, and number of stations within different radii (tenth-mile, quarter-mile, half-mile, three-quarter-mile, mile). Further, we calculated the mean distance between a station to all other stations in the city, and a nonlinear measure of geographic concentration as $\Sigma[1/(\text{distance} + 1)]^2 - 1$ from each station to all other stations within a particular city. This measure places greater weight on the closest geographic competitor stations.[2]
Table 1 summarizes the 2009 sample data, using price observations as the unit of analysis. Notice that, confirming popular opinion, there is considerable variation in price not only between cities but within cities. For example, the range between cheapest and most expensive regular grade gasoline is always more than ten percent and ranges as high as nineteen percent.

Further, while each city contributes at least one hundred separate stations in our sample, the cities vary markedly in terms of brand diversity, ranging from Wichita (where fifty-eight percent of all stations are split equally between QuikTrip and Phillips 66), to Raleigh (where the largest single brand is BP, at fourteen percent of all stations). Naturally, there is no evidence that these frequencies correspond perfectly to market share, as we do not have access to market-specific, brand-based sales data for the industry. Nevertheless, it is sufficient reason to include brand share as a potential explanatory variable in our analysis.

Table 1: Summary statistics

		Bakersfield	Colorado Springs	Pittsburgh	Raleigh	Tulsa	Wichita
Number of price observations		845	1007	682	814	719	942
Price for	mean	4.46	3.92	4.04	3.99	3.87	3.82
regular grade	min	4.19	3.79	3.89	3.79	3.69	3.63
	max	4.99	4.29	4.39	4.24	4.07	4.04
Price for premium grade	mean	4.61	4.11	4.30	4.21	4.06	4.02
	min	4.38	3.99	4.13	4.01	3.89	3.83
	max	5.69	4.39	4.49	4.45	4.45	4.34
Price for	mean	5.05	4.68	4.92	4.74	4.53	4.71
diesel grade	min	4.85	4.51	4.79	4.60	3.67	3.99
	max	5.19	4.99	5.59	4.88	4.79	4.89
Number of stations		106	134	141	160	129	116
Share of largest brand		0.17	0.17	0.21	0.14	0.18	0.29
Share of stations located in a highway location		0.46	0.29	0.26	0.25	0.26	0.29
Distance	mean	0.48	0.49	0.40	0.42	0.54	0.55
(in miles) to closest station	min	0.01	0.01	0.02	0.01	0.01	0.01

	max	3.88	4.04	1.48	2.03	2.59	3.00
Number of other stations within:							
0.1 miles	mean	1.26	1.08	0.69	1.08	0.41	0.46
	min	0	0	0	0	0	0
	max	4	4	5	6	3	3
0.25 miles	mean	2.50	3.14	1.78	2.76	0.87	1.56
	min	0	0	0	0	0	0
	max	8	11	8	13	5	6
0.5 miles	mean	7.95	10.60	4.37	7.24	4.29	7.02
	min	0	0	0	0	0	0
	max	21	24	15	20	15	17
0.75 miles	mean	14.80	20.42	7.53	13.58	8.96	14.81
	min	0	0	0	0	0	0
	max	31	47	23	32	28	30
1 mile	mean	24.36	32.63	11.04	21.79	14.77	24.06
	min	0	0	0	0	0	0
	max	46	75	30	51	40	44

Suspecting that a highway-side location might differentiate between types of consumers, or offer a marketing advantage to certain stations, we used GIS maps to identify stations which were obviously located in this manner. Aside from Bakersfield which confirms public stereotypes about California by having nearly half of all gas stations located next to a freeway, all other cities show a little over a quarter of all stations located near a highway.

In terms of spatial concentration, there is also some difference between the sample cities. Across all cities, the average distance from any given gas station to the nearest competitor is 0.40 and 0.55 miles. In all cities, there are ample examples of adjacent competitors. However, the Pittsburgh sample includes no examples of truly isolated stations (the maximum distance from any station to a competitor is 1.48 miles) while the Bakersfield and Colorado Springs samples include more isolated examples (where the distance to a nearest competitor is close to four miles). Drawing concentric rings around each station, we counted the number of competitors within given arbitrary radii, also presented in Table 1.

4.0 Model and estimation

We propose a simple reduced-form analysis of prices, in line with the literature (Hastings, 2004) as follows:

$$price = \alpha_0 + \sum_{i=1}^{2} \alpha_i grade_i + \sum_{i=1}^{10} \beta_i brand_i + \delta_1 highway + \delta_2 distance + u \qquad (1)$$

where
price is the observed price;
Grade is an indicator for regular or premium (with diesel as the excluded category);
Brand is an indicator for each distinct brand of station that occurred in more than three locations within a given market (with the remaining brands alongside independent stations serving as the excluded category);
Highway is an indicator of a highway-side location; and
Distance is a measure of proximity to competing gas stations (for which we use eight alternative measures).

We also consider an alternative model with brand shares, to permit the possibility that it is the relative presence of a brand in the market that predisposes particular pricing strategies, rather than a brand-specific effect. As noted above, we approximate brand share as the share of all observed stations in the sample that display a particular brand, as we cannot obtain data on sales shares. The alternative model is therefore:

$$price = \alpha_0 + \sum_{i=1}^{2} \alpha_i grade_i + \beta_1 brandshare + \delta_1 highway + \delta_2 distance + u \qquad (2)$$

where brandshare is the share of all gas stations in this market sharing the same brand as the observation;

We stop short of endogenizing location, leaving it for other scholars to model the location decision location by firms. Instead, we simply estimate equations (1) and (2) separately for each city, using a spatially-weighted regression to account for the presence of spatially-correlated errors. Spatial weights were created using a matrix of the pair-wise distances (in feet between property lines) between the station charging each observed price and every other price offered. Traditional unweighted regressions result show similar results, and tests are ambivalent about whether spatially correlated errors exist, varying by city. We elect to accommodate them.

Table 2 presents our primary results, using the number of competing stations within a quarter-mile radius as the measure of spatial concentration, controlling for brand-specific effects, highway-adjacent locations, and grade of fuel. All other radii or concentration measures considered show very similar results. The alternative model, including brand shares rather than brand-specific effects, is presented in Table 3 for comparison.

Notice first that the baseline price, represented by the estimated constant of each model, is fairly similar in each city (varying by less than ten percent from cheapest city to most expensive). Second, there was much more variation in the price discount from diesel grade fuel (the omitted grade for the purposes of estimation) to regular grade, a discount ranging from 57 cents per gallon in Bakersfield to 89 cents per gallon in Wichita. Premium-grade fuel prices fell between regular and diesel prices in all cases, with an average discount from diesel of 39 to 68 cents per gallon.

Brand effects are strong, when compared to the omitted category (which contains all other stations, including smaller brands in a particular market and independent stations). Some brands are consistently more expensive--- BP averages 3 to 5 cents a gallon higher than its peers depending upon the market, Citgo 7 to 9 cents, Conoco 0 to 15 cents, Exxon 6 to 7 cents, Mobil 4 to 9 cents, Phillips 0 to 2 cents, Shell 0 to 13 cents. The fact that there are no brands consistently cheaper than their peers in all sample cities is either a function of the value of branding in this sector, or could be explained by the fact that notable discount retailers (such as Costco and Sam's Club) infrequently had enough locations in a given market to permit an indicator variable. However, they generally averaged 1 to 10 cents below the market average.

There were also of course regional brands that showed dramatic results in particular locations, but which cannot be extrapolated across locations (e.g. Chevron at 18 cents above market in Bakersfield, Gulf at 9 cents above market in Pittsburgh). We also found it interesting that Safeway, a supermarket chain that advertises gas price savings to card members, averages prices almost exactly 3 cents per gallon higher than market prices, the precise amount of their savings to card members. King Soopers, a competing grocery chain in the same market with similar membership benefits, offers gas prices no different than market price to all customers, thus offering true savings to members.

Table 2: Spatial regression results, considering competitors within a quarter-mile radius, using brand-specific effects

	Bakersfield		Colorado Springs		Pittsburgh		Raleigh		Tulsa		Wichita	
Constant	4.975	(510.09)***	4.658	(531.08)***	4.896	(388.71)***	4.731	(567.28)***	4.562	(224.39)***	4.678	(437.63)***
Regular grade	-0.567	(75.20)***	-0.778	(126.23)***	-0.882	(95.65)***	-0.736	(111.10)***	-0.657	(53.26)***	-0.889	(117.48)***
Premium grade	-0.389	(43.45)***	-0.567	(95.87)***	-0.627	(70.97)***	-0.517	(79.23)***	-0.455	(34.48)***	-0.684	(85.89)***
Brand												
7-11	---	---	0.015	(1.96)**	---	---	---	---	---	---	---	---
76	---	---	---	---	---	---	-0.026	(2.38)**	---	---	---	---
AAFES	---	---	0.010	(0.79)	---	---	---	---	---	---	---	---
ARCO	0.007	(0.82)	---	---	---	---	---	---	---	---	---	---
BJs	---	---	---	---	---	---	-0.081	(6.28)***	---	---	---	---
BP	---	---	---	---	0.034	(2.41)**	0.054	(5.58)***	---	---	---	---
Cenex	---	---	---	---	---	---	---	---	---	---	0.023	(1.89)*
Chevron	0.180	(17.48)***	---	---	---	---	---	---	---	---	---	---
Citgo	---	---	---	---	0.089	(6.31)***	0.066	(7.38)***	---	---	---	---
CoGos	---	---	---	---	0.015	(0.49)	---	---	---	---	---	---
Conoco	---	---	0.145	(15.90)***	---	---	---	---	0.003	(0.18)	0.047	(5.03)***
Crown	---	---	---	---	---	---	-0.020	(1.89)*	---	---	---	---
Diamond	---	---	0.039	(5.06)***	---	---	---	---	---	---	---	---
Dillons	---	---	---	---	---	---	---	---	---	---	0.002	(0.24)
Exxon	---	---	---	---	0.060	(4.48)***	0.071	(6.98)***	---	---	---	---
FasTrip	0.028	(2.11)**	---	---	---	---	---	---	---	---	---	---
GetGo	---	---	---	---	-0.017	(1.05)	---	---	---	---	---	---
Gulf	---	---	---	---	0.089	(2.26)**	---	---	---	---	---	---
Hess	---	---	---	---	---	---	-0.012	(1.17)	---	---	---	---
Kangaroo	---	---	---	---	---	---	0.023	(1.50)	---	---	---	---
King Soop	---	---	-0.002	(0.26)	---	---	---	---	---	---	---	---
KumNGo	---	---	---	---	---	---	---	---	-0.076	(4.21)***	-0.016	(0.67)
KwikStop	---	---	---	---	---	---	---	---	---	---	-0.005	(0.56)
Midway	---	---	---	---	---	---	---	---	---	---	-0.001	(0.08)
Mobil	0.091	(8.56)***	---	---	---	---	0.039	(3.39)***	---	---	---	---
Murphy	---	---	---	---	---	---	---	---	---	---	---	---
Loaf & Jug	---	---	0.027	(3.02)***	---	---	---	---	---	---	---	---
Phillips 66	---	---	---	---	---	---	---	---	-0.015	(1.22)	0.016	(2.10)**
Resco	---	---	---	---	---	---	0.058	(3.51)***	---	---	---	---
Quik Trip			---	---	---	---			-0.046	(3.18)***	---	---
Safeway	---	---	0.028	(2.99)***	---	---	---	---	---	---	---	---
Sams Club	---	---	---	---	-0.027	(0.61)	---	---	---	---	---	---
Sheetz	---	---	---	---	-0.038	(2,97)***	-0.010	(0.64)	---	---	---	---
Shell	0.130	(14.22)***	0.088	(9.93)***	0.038	(1.80)*	0.070	(7.12)***	-0.002	(0.09)	0.089	(3.29)***
Sinclair	---	---	---	---	---	---	---	---	-0.030	(1.71)	---	---
Sunoco	---	---	---	---	0.010	(0.74)	---	---	---	---	---	---
Texaco	0.094	(8.56)***	---	---	---	---	---	---	---	---	---	---
Valero	---	---	---	---	---	---	---	---	---	---	0.051	(5.41)***
Western	---	---	-0.041	(5.89)***	---	---	---	---	---	---	---	---

Highway	-0.015	(2.38)**	-0.013	(2.52)**	-0.006	(0.84)	0.004	(0.72)	-0.024	(2.81)***	0.012	(1.78)*
Competitors	-2.34×10^{-3}	(1.09)	-2.56×10^{-3}	(3.58)***	1.41×10^{-3}	(0.69)	-0.010	(10.05)***	-3.75×10^{-3}	(1.10)	1.49×10^{-3}	(0.62)
R^2		0.878		0.958		0.938		0.958		0.864		0.949

Table 3: Spatial regression results, considering competitors within a quarter-mile radius, using brand share

	Bakersfield		Colorado Springs		Pittsburgh		Raleigh		Tulsa		Wichita	
Constant	4.981	(391.76)***	4.655	(529.43)***	4.916	(438.66)***	4.724	(691.58)***	4.556	(229.68)***	4.700	(476.69)***
Regular grade	-0.575	(70.79)***	-0.768	(119.43)***	-0.880	(90.37)***	-0.745	(114.70)***	-0.649	(53.85)***	-0.887	(118.08)***
Premium grade	-0.409	(44.21)***	-0.584	(92.22)***	-0.624	(66.33)***	-0.531	(89.34)***	-0.456	(34.98)***	-0.686	(83.92)***
Brand share	0.790	(11.54)***	0.536	(11.58)***	0.136	(2.21)**	0.635	(10.83)***	-0.080	(1.09)	-0.059	(2.23)**
Highway	-3.60×10^{-3}	(0.50)	-1.63×10^{-3}	(0.26)	-2.98×10^{-2}	(3.83)***	-1.66×10^{-2}	(2.81)***	-1.89×10^{-2}	(2.40)**	1.86×10^{-2}	(2.65)***
Competitors	-1.03×10^{-2}	(4.57)***	-2.77×10^{-3}	(3.34)***	2.22×10^{-3}	(0.11)	-1.02×10^{-2}	(11.68)***	-2.76×10^{-3}	(0.84)	1.45×10^{-3}	(0.68)
R^2		0.840		0.937		0.929		0.951		0.854		0.946

Highway-side stations are demonstrably cheaper in three of our six sample markets (where again, Wichita is the statistically significant counter-example), averaging one or two cents per gallon cheaper than their neighborhood-based peers.

Reflecting on the importance of branding, Table 3 shows that in four of our sample cities, brands with greater representation in the market charged higher prices, a result consistent with the microeconomic theory of oligopolistic behavior. Wichita shows the reverse pattern presumably because two brands (Phillips and QuikTrip) effectively control the Wichita market, and apparently lead in keeping gas prices lower in that city.

Finally, to reflect on the central hypothesis, *ceteris paribus*, it appears that greater spatial concentration of gas stations only serves to lower prices in a statistically significant manner in two (or perhaps three) of our six sample markets, Colorado Springs and Raleigh (with Bakersfield joining that list in the alternative specification of Table 3). This result is robust across all grades of fuel, as ancillary regressions (not reported here) that permit every coefficient to vary by market by grade of fuel show the same finding: only Colorado Springs and Raleigh see any effects of spatial concentration on price. In both cities, the effect is seen quite evenly across grades of fuel.

In each of these cases, the effects are economically trivial, a decline averaging one cent per competitor in Raleigh (and Bakersfield) and a quarter of a penny per competitor in Colorado Springs. In other words, prices might average by one to four cents per gallon on a particularly congested corner or block, an effect amounting to less than one percent of the purchase price.

This lack of evidence that spatial concentration matters is probably not due to brand effects. A model that excludes all information about brands (no brand-specific indicators and no brand share information) shows similarly insignificant effects of spatial competition on price. While we recognize that brand location may be endogenous, as some brands may choose to locate in areas congested with competitors (or that congestion may follow particular brand location choices), we are not equipped with the historical data to test that possibility, as it would require a model of the dynamic choices by firms to choose particular locations. We encourage future scholars to pursue this direction.

Naturally, there may be other factors which exert influence on the prices charged by individual stations. For example, the presence of a car wash, the hours of operation, the friendliness of the staff, the accessibility and cleanliness of the location might all play into a consumer's willingness to pay for gas (or a firm's ability to charge for it). However, the coefficients of determination, ranging from 0.84 to 0.95, are sufficiently high to cause us to reflect that most of the story is either told by our chosen variables or is tightly correlated with them. In fact, the authors made phone calls to ascertain various other details about the stations in our sample, and were met with universal paranoia that we represented either a terrorist or collusion-based industrial threat, to the degree that we discontinued our phone investigations.

5.0 Conclusion

To our knowledge, this is the first full spatial econometric analysis of the retail gas market, and we present it to stimulate discussion about the topic and method. Microeconomic theory indicates quite clearly that firms located proximate to one another should charge lower prices, whether argued via Hotelling's Theorem of spatial competition within markets, or oligopolistic competition and Bertrand's model of duopoly.

Yet our evidence across six U.S. cities indicates either that spatial concentration largely does not matter, or that it is so very co-related with brand positioning that it is therefore impossible to identify statistically. In either case, it appears that gas station location does not, in itself, affect retail gas price at an appreciable level.

That seems to suggest the possibility of localized monopolies, where a brand dominates a neighborhood so thoroughly as to minimize any impact of competition by other nearby retailers. That concern is supported by the result that highway stations appear to have slightly lower prices, as presumably consumers frame the "localness" of their consumption decision differently when they are already on or near the highway.

This result could be interesting for firms choosing their next location, or for city planners aiming to distribute commercial space in a thoughtful manner. Given the paucity of evidence that local competition affects price, this might be a starting point for investigation into (locally) non-competitive behavior by gas retailers. It should definitely be a call to researchers to continue this line of empirical testing, since apparently the theory of spatial

competition does not apply in this market. We hope that future investigation will clarify why that is the case: consumer willingness to pay for brandedness, producer monopolization of local markets, or something else.
Our results are probably of most interest to consumers, who for now might take this simple advice: on average, shopping around for an intersection congested with gas stations will not pay off with discounted prices. Instead, find an appropriate station brand near a highway, and leave the rest up to statistical averages.

Endnotes

1. The complete list of 29 isolated mid-sized US cities includes: Anaheim, CA; Anchorage, AK; Arlington, TX; Aurora, CO; Bakersfield, CA; Cincinnati, OH; Cleveland, OH; Colorado Springs, CO; Corpus Christi, TX; Henderson, NV; Honolulu, HI; Lexington, KY; Lincoln, NE; Long Beach, CA; Mesa, AZ; New Orleans, LA; Oakland, CA; Omaha, NE; Pittsburgh, PA; Raleigh, NC; Riverside, CA; Sacramento, CA; St. Louis, MO; St. Paul, MN; Tampa, FL; Toledo, OH; Tulsa, OK; Virginia Beach, VA; and Wichita, KS.
2. The constant (one) was added to the distance measure in order to prevent division by zero in making the calculation. To then prevent a value of one from appearing on the distance matrix diagonal, one was subtracted from the sum.

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