『東西硏究』 제 33 권 1호 (2021) pp. 125-145
http://dx.doi.org/10.29274/ews.2021.33.1.125

Location Choice and Price Competition: The Case of the Gasoline Market in Seoul

Donghun Kim ▌ Yonsei University*

〈Abstract〉

We analyzed the locational pattern and price competition among gas stations in Seoul using station-level panel data. Results indicate that population density, land price, station brand concentration, and car ownership per person were important determinants of location. There was a significant brand specific price differential and it was in part attributable to the exercise of market power. Ancillary services of stations were found to be statistically significant factors regarding pricing decisions. This verifies that gas stations differentiate themselves in the spatial and product characteristic dimensions to soften price competition. Meanwhile, station density, measured by the number of stations within a 1km or 2km radius of a station, intensified price competition and lowered equilibrium prices. Specifically, the increase in independent stations that do not use refinery brands had a much stronger competitive effect on equilibrium prices. From the perspective of competitive policy, lowering the entry costs of independent is of paramount importance in order to enhance market competition and improve consumer welfare.

*Keywords: Gasoline stations, Location choice, Price competition, Spatial competition, Pricing relationship
JEL Code: L11, L13, C30

Ⅰ. Introduction

Gasoline is considered a perfectly homogenous good in terms of its

* Professor, Yonsei University Graduate School of International Studies
(E-mail: dhkim2@yonsei.ac.kr)

physical and chemical properties. Competition in the gasoline market is highly localized and gas stations are engaged in direct competition only with close geographical competitors. Gas stations incur substantial entry and exit costs and two-stage models, with the choice of location in the first stage and price competition in the second stage, can capture the crucial features of the retail gasoline market very well(Nets and Taylor, 2002). Spatial competition models such as those by Hotelling(1929) have explored the issues of the equilibrium pattern of firm location and the equilibrium prices under spatial competition among firms.

In this paper, we investigate how gas stations operating in the retail gasoline market select their locations and engage in price competition in Seoul. So far, the multi-dimensional aspect of location choice and price competition in the Korean gasoline market has not much been explored in the literature.[1] First, we explore how the geographical density of gas stations is related to demand factors such as population density and vehicle density in various regions. We then analyze the determinants of price competition in the market. As gasoline itself is conceived as a homogenous good, gas stations differentiate their products through the provision of ancillary services, such as car wash and repair service to mitigate price competition. We investigate the roles of station characteristics on the intensity of price competition. In particular, we study how station density affects the level of equilibrium prices. As the retail gasoline market is characterized by a strong spatial dimension, this feature can be used to identify the competitive behaviors of gas stations.

1) Among the studies on Korean gasoline markets, Kim et al.(2012) evaluated the entry of independent station on the equilibrium gasoline prices using the difference-in difference estimation. Kim and Lee(2014) estimated a spatial differentiation model for the Korean gasoline market using data that ranged from April 2008 through February 2010, but they did not analyze the locational pattern of gas stations. Choi et al.(2019) investigated how information frictions between consumers and retailers influence the asymmetry of price dispersion in 25 regions in Seoul, Korea. Kim(2018) used an office land price as a proxy of location and investigated the spatial effects of competing gas stations.

If stations compete each other, the nearer they are to each other, the lower the equilibrium prices should be. However, if stations collude with each other, no systematic relationship can be expected between station density and price. A positive relationship between station density and price may result from the coordination of pricing if stations are located nearer to each other. Thus, this spatial dimension of the market allows us to identify market conduct and eliminates the need to use market concentration - price relationships. To estimate the model of competition, we collected gas station-level variables, including prices and ancillary services such as car wash and charging services.

The rest of this paper is organized as follows. In section II, we specify the estimation models and explain the data used for estimation. The results of the empirical analyses are presented in section III. We conclude the paper in section IV.

II. Model and Data

1. Model Specification

Several approaches have been used to analyze spatial price competition in gasoline markets. Pinkse et al.(2002) specified a spatial price competition model for differentiated products and investigated the U.S. wholesale gasoline market. Pennerstorfer(2009) analyzed the impact of unbranded gas stations on competition in the Austrian gasoline market using a similar model to Pinkse et al.(2002). Manuszak(2009) developed a gasoline demand model that incorporates product differentiation from the locations of gas stations in the Hawaiian retail gasoline market. Houde(2012) estimated a model of spatial competition where spatial differentiation comes from the structure of the road network and traffic flows. Kim and Lee(2014) estimated a model of spatial differentiation for the Korean gasoline retail market and found that the prices of neighboring gas stations are spatially correlated in the market.

In this paper, we explore the models of locational pattern of retail gas stations and price competition in Seoul. Spatial competition models such as Salop(1979) indicate that each consumer purchases at the store where the total cost of shopping, which consists of product price and transportation costs, they have to incur to purchase the product is the smallest. Therefore, each store is a local monopolist whose market share is dependent on the prices charged by the nearest competitors and the transaction costs consumers have to incur to purchase at different shops. In a location decision, firms face two opposing incentives that generate mixed results(Nets and Taylor, 2002). First, firms have an incentive to locate products close to competitor's products in an attempt to capture more consumers, referred to as market share effect(Pinske and Slade, 1998). Meanwhile, the reduction in spatial or product differentiation can lead to greater price competition. Therefore, firms have incentive to locate farther from their rivals to reduce the competition, which is referred to as market power effect. Which effect dominates, the market share or the market power effect, depends on the assumptions made in the models and the characteristics in the markets. Nets and Taylor(2002) tested location patterns of gas stations in the Los Angeles basin retail gasoline market and found that the market power effect was dominant. In this paper, we do not directly examine whether the locational patterns of gas stations in Seoul are consistent with the market power or the market share effect. Rather, we investigate the characteristics that drive the equilibrium location results. We then explore, given the chosen locations, how the characteristics of gas stations affect price competition. We expect the equilibrium pattern of locations to be affected by the distribution of consumer locations, the elasticity of demand, the form of the transportation cost, and consumer heterogeneity. Anderson et al.(1992) suggested that the equilibrium number of firms per unit of distance in a spatial competition model is proportional to the number of consumers per unit of distance and disproportional to the fixed entry cost. Therefore, we specify the following equation for location choice considering the previous literature and the data availability:

$$Stden_{jt} = \alpha_0 + \alpha_1 \cdot Popden_{jt} + \alpha_2 \cdot Vperprsn_{jt} + \alpha_3 \cdot landcost_{jt} + \alpha_4 \cdot HHI_{jt} + \mu_j + \nu_{it} \quad (1)$$

In equation (1), $Stden_{jt}$ is station density in district j at time t. The station density is calculated as the number of gasoline stations per square kilometer. $Popden_{jt}$ is population density measured by the population per square kilometer in district j at time t. The demand of the stations will obviously depend not only on the number of consumers but also the demand per consumer. The per capita demand will also depend on per capita income. In terms of the demand for gasoline, the number of cars per capita($Vperprsn_{jt}$) can be used as a proxy for the per capita income because we do not observe the district-level per capita income in Seoul. $Landcost_{jt}$ represents land price in each district, measured by the price index reported by the Korea Appraisal Board. Land price would affect the fixed cost of entry if the gas station sites were purchased by station owners. It also can affect operational cost if the owners of the stations are paying rents. In both cases, land price can play a role of entry barrier and negatively affect the density of the stations. HHI_{jt} is brand Herfindahl index, which is measured by the sum of the square of the market share in each district. This measure is different from the conventional measure of the Herfindahl index in that the market share is measured by the proportion of gas stations selling gasoline under the same refinery brand name rather than by individual stations' share of sales volume. The sales volumes are generally not observed by researchers in gasoline markets. Our study examines five brand names:

SKE, GSC, HDO, SOL, and Others. “Others” represent independent gas stations that do not use the brand names of the four majors. Theoretically, it is not clear how the concentration of brand ownership will affect the density of firms. In gasoline markets, there are two dimensions of competition, inter-and intra-brand competition. If the inter-brand competition is greater than intra-brand competition while certain types of coordination exist among the stations selling the same brand, the disproportionate increase in the number of stations using particular brands, which does increase the Herfindahl index, may act as barriers to the entry of other brands. In this case, the Herfindahl index can have a negative effect on the density of gas stations per square kilometer. μ_j represents district fixed effect, which captures time-invariant unobserved differences in the density of stations across the districts. The term, ν_{it} is an error term. A shortcoming of the fixed effects model is that it does not take the endogeneity of time-variant independent variables into account. For example, brand Herfindahl index HHI_{jt} can affect gas stations density but it can also be affected by the station density in the districts. Therefore, we estimated a dynamic panel data model using the system GMM(Generalized Method of Moments) to control for the endogeneity of the variables(Arellano and Bover, 1995; Blundell and Bond, 1998).

In this paper, it is assumed that gas stations engage in price competition once their locations are decided.[2)] As gasoline is physically homogeneous, gas stations use ancillary services such as car wash for product differentiation. Therefore, we specify the pricing relationship equation as the function of gas station characteristics and wholesale

---

2) In this paper, we assume that gas stations engage in price competition once their locations are decided. This is equivalent to assuming that there is no correlation between the error terms of equation (1) and equation (2). This paper could not consider the correlation when the equations were estimated due to the differences in the level of data used in the models. This is a caveat in the paper.

refinery prices:

$$p_{it} = \beta_0 + \beta_1\, SKE_i + \beta_2\, HDO_i + \beta_3\, GSC_i + \beta_4\, PBR_i + \beta_5\, Self_i + \beta_6\, CVS_i + \beta_7\, Wash_i + \beta_8\, Charge_i + \beta_9\, Tuneup_i + \beta_{10}\, Wh24_i + \beta_{11}\, r\_nkm_{it} + \beta_{12}\, Pbr\_nkm_{it} + \beta_{13}\, Wholesale_{it} + \beta_{14}\, t + \beta_{15}\, t^2 + \beta_{15} + \varepsilon_{it} \qquad (2)$$

where p_{it} is the price of gasoline at station i at time t,; SKE_i, SOL_i, HDO_i are brand dummies and PBR_i is an indicator for an unbranded station. The characteristics of gas stations include the dummy variables for a self-service station($Self_i$), having a convenient store(CVS_i), station services such as car washing($Wash_i$) and charging($Charge_i$). They also include the dummy variables for tune-up service($Tuneup_i$), 24 hours operating stations($W24_i$). The variable, r_nkm_{it}, represent the number of gas stations within a radius of 1km or 2km from station i, respectively. In addition, Pbr_nkm_{it} denote the number of unbranded stations in the neighborhood(defined by the distances of 1km, or 2km, respectively) of station i. The variables, r_nkm_{it} and Pbr_nkm_{it} are used alternatively to capture the competitive pressure in the market. The variable, $Wholesale_{it}$ represents wholesale price. We added a quadratic time trend, $\beta_{14}\, t + \beta_{15}\, t^2$ to control for the persistent time trend which might be affected by the entries and exits of gas stations and the structure of gasoline supply chain. The last term, ε_{it}, is an error term.

2. Data

<Table 1> summarizes the variable description and source. <Table 2> shows the samples statistics for 25 district in Seoul. Station density is defined as the number of stations in per square kilometer. Population density is measured by the population per square kilometer in each district. Land price is measured by the price index reported by the Korea Appraisal Board. HHI brand Herfindahl index, which is measured by the sum of the

square of the market share in each district. The information on population and vehicle ownership was obtained from the Korean Statistical Information Service(KOSIS). <Table 3> shows the sample statistics for the prices and the characteristics of gas stations. Our sample included all these stations in Seoul and the data range is from January 2011 through December 2015. The total number of service stations operating in Seoul was 587.[3] Among them, 242 stations used SKE brand gasoline, and 156 stations sold gasoline under the GSC brand. HDO and SOL accounted for 85 and 76 stations, respectively. Independent, unbranded stations totaled 28. The definition of stations characteristics were explained in the previous section.[4] The information on prices and station characteristic were obtained from the oil price information network(Opinet).

〈Table 1〉 Variable Description and Source

Variable	Description	Source
$Stden_{jt}$	Station density in district j at time t	Author's calculation from Opinet
$Vperprsn_{jt}$	The number of cars per capita district j at time t	Author's calculation from KOSIS
$Popden_{jt}$	Population per square kilometer in district j at time t	Author's calculation from KOSIS
$Landcost_{jt}$	Land price in each district	Korea Appraisal Board
HHI_{jt}	Brand Herfindahl index	Author's calculation from Opinet
p_{it}	Price of gasoline at station i at time t	Opinet
$Self_i$	Dummy variables for a self-service station	Opinet
$Wash_i$	Dummy variables for car washing service	Opinet
$Charge_i$	Dummy variables for charging service	Opinet
$Tuneup_i$	Dummy variable for tune-up service	Opinet
CVS_i	Dummy variable for having a convenient store	Opinet

3) Seoul is the capital of South Korea and it is located in the center of the Korean peninsula. 9.86 million people were living in the 25 districts of Seoul(see Appendix 1).

4) The number of stations in the radius was calculated using the algorithms provided by the NAVER, a widely used Korean online platform operated by the Naver Corporation.

Variable	Description	Source
$W24_i$	Dummy variable for 24 hours operating stations	Opinet
r_nkm_{it}	The number of gas stations within a radius of 1km or 2km from station i	Author's calculation from Opinet
Pbr_nkm_{it}	The number of unbranded stations in the neighborhood(defined by the distances of 1km, or 2km, respectively) of station i	Author's calculation from Opinet
$Wholesale_{it}$	Wholesale gasoline price	Opinet

〈Table 2〉 Sample Statistics for District-level Data

Variable	Mean	Std. Dev.	Min	Max
$Stden_{jt}$	1.692	0.398	0.708	2.473
$Vperprsn_{jt}$	0.244	0.058	0.167	0.397
$Popden_{jt}$	28,344	8,130	12,190	46,143
$Landcost_{jt}$	93.518	2.282	85.577	98.005
HHI_{jt}	0.312	0.068	0.222	0.575

Note: The total number of observations is 1,500

〈Table 3〉 Sample Statisticsfor Gas Stations

Variable	Mean	Std. Dev.	Min	Max
p_{it}	1915.82	218.44	1329.42	2490
$Self_i$	0.23	0.42	0	1
$Wash_i$	0.699	0.045	0	1
$Charge_i$	0.004	0.062	0	1
$Tuneup_i$	0.264	0.441	0	1
CVS_i	0.079	0.27	0	1
$W24_i$	0.255	0.436	0	1
r_1km_{it}	4.48	2.33	0	12
r_2km_{it}	15.18	5.7	1	31
Pbr_1km_{it}	0.253	0.506	0	3
Pbr_2km_{it}	0.901	1.01	0	4
$Wholesale_{it}$	1715.43	178.57	1286.84	1979.51

Note: The total number of observations is 29,392

III. Results

<Table 4> shows the GMM result of the station density equation. The equation was estimated in logarithm form to obtain unit free percentage interpretation for the estimated coefficients. We reported the results of OLS and the fixed effect model for comparison. However, the result of OLS suffer from the problems of endogeneity of the variables and the omitted variables bias. The fixed effect model can consider the effect of time-invariant district effects but it cannot control for time variant endogeneity problem. Therefore, we focus on the result of the GMM. The results of the system GMM show that the four variables in the model are statistically significant determinants of the location of gas stations.5) As expected, population density has a positive effect on station density. The number of cars per capita is positive and statistically significant. Meanwhile, the Herfindahl index is negative and significant, which may suggest that the concentration of gasoline brands may act as entry barriers. In particular, the size of the Herfindahl index on station density increases in absolute value from 0.379 to 0.658 when we move from the OLS to the GMM results. This suggests that disregarding the correlation between the Herfindahl and the can cause the downward bias of the coefficients on the Herfindahl index. The direction of the bias depends on the correlation between the error term and the Herfindahl index. It seems that the unobserved effects, which affects station density, is positively correlated with the Herfindahl index. The positive correlation tends to shrink the coefficients in the OLS model in absolute value when the

5) For the GMM estimation, we used the linear dynamic panel data(DPD) estimation technique. The lagged independent variables were used as instrumental variables in the difference equation. Arellano-Bond autocorrelation test for the fist-difference errors indicates that the no autocorrelation of order 1 and order 2 cannot be rejected with p-values of 0.14 and 0.16, respectively. The null hypothesis that overidentifying restrictions are valid cannot be rejected with the p-value of 1.00.

coefficients is negative. We can apply the same logic to the other coefficients. Land price has a negative effect on station density and high land price deters the entry of gasoline stations and forces the exit of existing stations.

〈Table 4〉 Results of Station Density Equation

Variables	Dependent Variable: In($Stden$)$_{jt}$		
	OLS	Fixed Effect	GMM
In ($Popden$)$_{jt}$	0.615 (0.026)***	0.814 (0.057)***	0.498 (0.099)***
In ($Vperprsn$)$_{jt}$	0.832 (0.037)***	-0.006 (0.054)	0.208 (0.076)***
In (HHI)$_{jt}$	-0.379 (0.034)***	-0.032 (0.017)*	-0.658*** (0.183)
In ($Landcost$)$_{jt}$	-1.187 (0.205)***	-1.567 (0.089)***	-0.387 (0.109)***
Constant	0.341 (1.023)	-0.758 (0.765)	-1.737 (0.613)**
R-squared	0.434	-	
Number of Observations	1,500	1,500	1,500
Fixed Effect	X	O	O
Instrumental Variables	X	X	O
Sagan Overidentification Test	-	-	Chi2(1140)=18.52 (p-value=1.0)

Note: *, **, ***: significant at the 10%, 5%, and 1% levels, respectively

〈Table 5〉 Results of Pricing Equations

Variable	Model (1)	Model (2)	Model (3)	Model (4)
Constant	549.14 (17.09)***	545.94 (15.49)***	562.57 (18.66)***	567.97 (15,34)***
SKE_i	90.13 (13.35)***	87.33 (11.28)**	89.59 (11.27)***	81.40 (10.95)***
GSC_i	30.96 (11.32)**	36.67 (11.13)**	40.91 (11.12)**	32.76 (10.61)**
HDO_i	-20.19 (11.07)**	-22.27 (10.98)**	-18.47 (11.03)**	-17.24 (10.86)
PBR_i	-54.18 (12.62)***	-56.89 (12.95)***	-50.45 (12.59)***	-57.55 (12.74)***

Variable	Model (1)	Model (2)	Model (3)	Model (4)
$Self_i$	-74.34 (7.93)***	-71.73 (7.93)***	-74.78 (7.99)***	-71.99 (7.90)***
$Wash_i$	2.31 (9.18)	2.34 (9.09)	2.29 (9.16)	1.15 (8.89)
$Charge_i$	70.29 (63.93)	62.13 (64.91)	68.89 (59.61)	89.80 (58.83)
$Tumeup_i$	17.64 (10.46)*	17.05 (10.30)*	18.11 (10.34)*	16.39 (9.89)*
$Wh24_i$	-12.34 (10.69)	-9.83 (10.72)	-13.05 (10.73)	-10.40 (10.48)
CVS_i	47.94 (21.37)**	46.34 (21.41)**	49.05 (21.56)**	44.75 (21.58)**
$Wholesale_{it}$	0.76 (0.007)***	0.71 (0.008)***	0.76 (0.006)***	0.76 (0.006)***
r_1km_{it}	-2.24 (1.79)			
r_2km_{it}			-1.55 (0.75)**	
Pbr_1km_{it}		-19.65 (6.56)***		
Pbr_2km_{it}				-24.88 (3.33)***
t	4.74 (0.30)***	4.73 (0.30)***	4.74 (0.30)***	4.73 (0.30)***
t^2	-0.10 (0.005)***	-0.10 (0.004)***	-0.10 (0.005)***	-0.10 (0.004)***
R-squared Within Between Overall	 0.87 0.55 0.67	 0.87 0.55 0.67	 0.87 0.55 0.67	 0.87 0.55 0.67

Note: The total number of observations is 29,379. Clustered robust standard errors are shown in parentheses. *, **, ***: significant at the 10%, 5%, and 1% levels, respectively

<Table 5> shows the results of pricing equation. The equation was estimated using the random effect(RE) model. There are many time-invariant dummies variables in the equation and the application of the fixed effect(FE) was not feasible. We reported the clustered robust

standard error. We specified four types of models. In Model (1), we used the number of gas stations within a 1km radius as an independent variable that captures the degree of competition. If the market is competitive, the increase in the number of stations will intensify price competition and lower the equilibrium price. However, if coordination exists among the stations, the increase in the number of gas stations will not necessarily lead to lower equilibrium prices. The equilibrium price may even increase if gas stations are engaged in coordinated pricing. In Model (2), we included the number of independent gas stations within a 1km radius (Pbr_1km_{it}) assuming that the role of independent stations will be different from branded stations in the promotion of price competition. Independent stations tend to charge more competitive prices to infiltrate the market and expand their market shares. They usually provide ancillary services such as bonus points and gift cards less intensively than branded stations. In Models (3) and (4), we used a 2km radius instead of a 1km radius to count the numbers of stations around a particular gas station. It is an empirical question if market competition exists within 1km or 2km radius. We therefore tested the boundary of competition using the alternative measures.

In the results, SKE, HDO, GSC are dummy variables for refinery brands and PBR is a dummy variable for independent brands. The base brand is SOL. The prices of SKE and GSC gas stations are higher than SOL brand stations but those of HDO and PBR are much lower than the base brand stations. This may suggest that there is vertical coordination in pricing by the refineries to the same brand gas stations. SKE gas stations represented the largest share in sales volume and the number of gas stations and they charged the highest price in the market. This can be inferred as the exercise of market power. GSC stations, representing the second largest share, were charging price much higher than that of SOL stations. Meanwhile, HDO stations had a different strategic pricing. They charged much lower price than SOL stations even though HDO stations had much higher market share. This may suggest that HDO stations were pricing competitively to sustain their market share. The prices of independent stations were on average about 55 Won per liter lower than the SOL brand stations. The coefficient of Self indicates that self-service stations charge around 72 Won per liter lower than other stations. Ancillary services such as car wash and tune-up may have positive impacts on prices. For example, car wash services are usually provided at a discounted price or for free if gasoline is purchased. Thus, part of the service charge is transferred to higher gasoline retail prices. The same rationale can be applied to other services. Meanwhile, the prices in gas stations operating for 24 hours ($Wh24_i$) a day can be lower than other counterparts as stations that operate 24 hours a day tend to charge competitive prices to attract customers and expand market shares. However, the results in the table indicate that only the coefficients on $Tuneup_i$ and CVS_i were statistically significant. In the case of the number of stations within a 1km radius, it has a negative but insignificant effect on the price. However, the coefficients on r_2km_{it} was negative and significant at the 5%. Therefore, the increase in the density of stations within a 2km radius tends to increase market competition. We therefore infer that the gasoline market can be delineated too narrowly if a 1km radius is used to define the market. In the case of the coefficient on the number of independent stations, it was found to be significant within a 1km radius at the 1%. It was found that the coefficient of Pbr_2km_{it} is negative and statistically significant at the 1 and it is greater in absolute value than that on r_2km_{it} in Model (3). Therefore it can be inferred that the competitive effect of independent stations is much greater than branded stations. The coefficients on the quadratic time trend were strongly significant. This may suggest that the equilibrium price was affected by the change in market conditions such as entries and exits.

IV. Conclusion

In this paper, we analyzed the locational patterns and price competition of gas stations in Seoul. Population density, land price, station brand concentration and car ownership per person were found to be the most important factors in the determination of the location of gas stations. There was a significant price difference among different brands stations. This can be inferred that gasoline stations were changing different prices which were correlated with refinery brand names, with other factors which might affect the level of prices controlled for. Branded gasoline stations with jointly having the large shares in the market were changing much higher prices than small share branded stations. This can be inferred as the exercise of market power as there is no reason that large share brand stations had higher marginal costs. Meanwhile, relatively small share branded stations were charging price competitively to sustain market share.

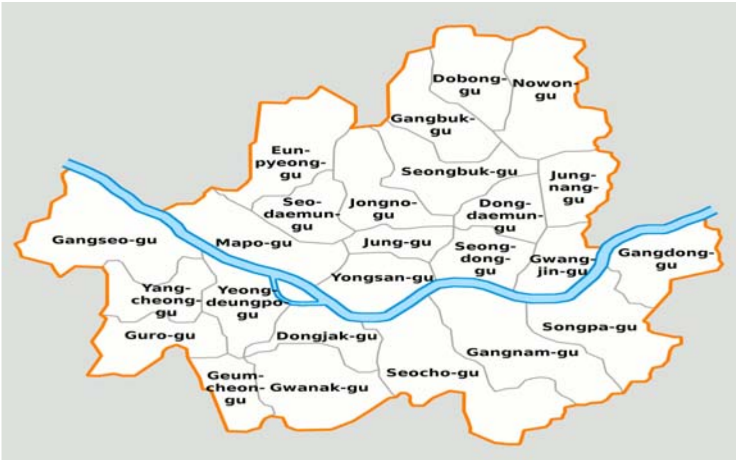
Ancillary services such as tune-up service and having convenient store were also revealed to be statistically significant factors in the pricing decision of gas stations. This confirms that gas stations differentiate both in spatial and product characteristics dimensions to soften price competition. In contrast, station density, measured by the number of stations within a 1km or 2km radius of a station, intensified price competition and lowered equilibrium prices. In particular, the increase of independent stations that do not use refinery brands had a much stronger competitive effect on the equilibrium prices.

In terms of policy point of view, it can be inferred the infiltration of independent stations in the market will enhance market competition and improve consumer welfare with low prices. However, an obstacle of such an infiltration is that the perceived entry cost by independent stations is much higher than branded stations whose entry costs are subsidized by refineries. Narrowing down the gap in entry cost would be of paramount importance from the perspective of competition policy in order to enhance market competition.

In the paper, we explored the determinants of station density but we did not analyze how market competition affects spatial distances among gas stations in the market. Gas stations have an incentive to locate themselves close to competitors in order to capture more market share. They also have an incentive to locate themselves farther from their rivals to reduce competition. Exploring which effect dominates can be an avenue of future research.

Appendices

[Appendix 1] Districts in Seoul



[Appendix 2] Correlation coefficients for gas station variables

	Price	Self	Wash	Charge	Tuneup	CVS	Wh24	SKE	GSC	HDO	r_1km	r_2km	Pbr_ 1km	pbr_ 2km	wholesale
Price	1.000														
Self	-0.171	1.000													
Wash	0.029	0.172	1.000												
charge	0.029	-0.034	0.041	1.000											
Tuneup	0.009	0.157	0.299	-0.038	1.000										
CVS	0.058	0.137	0.145	-0.016	0.126	1.000									
Wh24	-0.016	0.166	0.189	-0.037	0.221	0.183	1.000								
SKE	0.163	0.073	0.172	0.014	0.119	0.194	0.160	1.000							
GSC	0.010	-0.088	-0.069	-0.039	-0.029	-0.043	0.012	-0.523	1.000						
HDO	-0.124	-0.033	-0.043	0.062	-0.055	-0.098	-0.100	-0.339	-0.255	1.000					
r_1km	-0.014	-0.017	-0.028	0.032	0.097	-0.009	0.083	0.0026	0.005	0.022	1.000				
r_2km	-0.048	-0.064	-0.045	-0.007	0.063	0.011	-0.007	-0.035	-0.005	0.059	0.578	1.000			
pbr_ 1km	-0.052	0.076	0.001	-0.032	0.046	-0.056	0.131	-0.033	-0.066	0.059	0.246	0.198	1.000		
pbr_ 2km	-0.153	0.001	-0.063	0.047	-0.010	-0.060	0.026	-0.089	-0.088	0.164	0.159	0.428	0.476	1.000	
wholesale	0.767	-0.028	-0.007	-0.001	-0.002	-0.007	-0.014	-0.043	0.046	0.012	-0.002	-0.005	0.012	0.001	1.000

[Appendix 3] Correlation coefficients for district-level variables

	Stden	Popden	Vperprsn	HHI	Landcost
Stden	1.0000				
Popden	0.3289	1.0000			
Vperprsn	0.1485	-0.5214	1.0000		
HHI	-0.1272	-0.1276	0.4157	1.0000	
Landcost	-0.2376	-0.0299	-0.2550	-0.2371	1.0000

References

Anderson, S, A.de Palma and J.-F. Thisse. 1992. *Discrete Choice Theory of Product Differentiation*. Cambridge, MA: MIT Press.

Arellano, M. and Bover, O. 1995. "Another Look at the Instrumental Variable Estimation of Error Component Models." *Journal of Econometrics* 68(1), 29-51.

Blundell, R. and Bond, S. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Models." *Journal of econometrics* 87(1), 115-143.

Choi, Bongseok, Donghun Kim and Hong Chong Cho. 2019. "Price Dispersion, Information, and Asymmetry of Price Dispersion." *Applied Economics* 51(39), 4270-4281.

Salop, SC. 1979. "Monopolistic Competition with Outside Goods." *Bell J Economics* 8(1), 141-156.

Hotelling, Harold. 1929. "Stability in Competition." *Economic Journal* 39(153), 41-53.

Houde, Jean-Francois. 2012. "Spatial Differentiation and vertical Mergers in Retail Markets for gasoline." *American Economic Review* 102(5), 2147-2182.

Kim, Donghun, Kim, Hyungun and Lee, Jiyeon. 2012. "Competitive Effects of Independent Gas Stations." *Korean Journal of Industrial Organization* 20(3), 1-21.

Kim, Donghun and Lee, Jiyon. 2014. "Spatial Price Competition in the Korean Retail Gasoline Market." *Environmental and Resource Economics Review* 23(4), 553-581.

Kim, Hyung-gun. 2018. "Price Competition in Korean Retail Gasoline Market: Focusing on Spatial Effects." *Journal of Distribution Science* 16(4), 83-88.

Manuzak, Mark D. 2010. "Predicting the Impact of Upstream Mergers on Downstream Markets with Application to the Retail Gasoline

Industry." *Industrial Journal of Industrial Organization* 28(1), 91-111.

Nets, Janet S. and Beck A. Taylor. 2002. "Maximum or Minimum Differentiation?: Location Patterns of Retail Outlets." *Review of Economics and Statistics* 84(1), 62-175.

Pennerstorfer Dieter. 2009. "Spatial Price Competition in Retail Gasoline Markets: Evidence from Austria." *Annals of Reginal Science* 43(1), 133-158.

Pinkse, Joris and Margaret E. Slade. 1998 "Contracting in Space: An Application of Spatial Statistics to Discrete-Choice Models." *Journal of Econometrics* 85(1), 125-154.

Pinkse, Joris, Margaret E. Slade, and Crgaig Brett. 2002. "Spatial Price Competition: A Semiparametric Approach." *Econometrica* 70(3), 1111-1153.

국문요약

주유소 위치선정과 가격경쟁: 서울시 휘발유 시장을 중심으로

김동훈 ▌ 연세대학교

이 논문은 주유소 수준의 패널데이타를 이용하여 주요소 간 경쟁을 분석하였다. 논문의 분석 결과에 따르면 주유소 위치선정의 중요한 결정요인은 인구밀집도, 지가, 주유소 브랜드의 집중도, 개인별 자동차 소유 대수에 의하여 결정되었다. 주유소의 가격은 정유사 브랜드 별로 차이가 있으며 이는 어느 정도 시장지배력에 기인한 것으로 추정되었다. 주유소의 보조서비스는 주유소 휘발유 가격에 영향을 미치는 것으로 나타났다. 이는 또한 주유소들이 제품특성이나 공간적 차별화를 통해 가격경쟁을 완화시키는 것으로 해석되었다. 1km 또는 2km 반경의 주유소 밀집도는 가격경쟁을 격화시키며 균형가격을 하락시키는 것으로 추정되었다. 특히 비정유사 브랜드는 균형가격에 더 큰 가격경쟁을 촉진시키는 것으로 평가되었다. 경쟁정책의 관점에서는 비정유사 브랜드의 진입비용을 낮추는 것이 시장경쟁을 제고하고 소비자 후생을 증가시키는 중요한 요인으로 평가되었다.

주제어: 주유소 위치, 가격 경쟁, 공간 경쟁, 가격 설정

❑ 논문접수일: 2021년 1월 20일, 심사완료일: 2021년 3월 8일, 게재확정일: 2021년 3월 8일