Pricing Puzzle in a Retail Gasoline Market

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Abstract

In this paper, we seek to explain a pricing puzzle in the retail gasoline market by testing various theories. The pricing puzzle we found is the persistent price discrepancy of regular unleaded gasoline between multi-product stations selling premium and regular gasoline together and single-product stations selling only regular gasoline. Our empirical investigation showed that the significance of price differentials continued to exist even if various factors such as the product differentiation, brand/station effects, and spatial competition are controlled. We discuss a theory that premium stations may set the price of regular gasoline high so as to make the quality salient and to increase the sales of premium gasoline, although this theory is not completely proven.

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1. Introduction

Sometimes we observe unusual pricing by firms. For example, in the Korean canned beer market, list prices of imported canned beers are set higher than domestic canned beers, but they are usually sold at discounted prices. Why do they set the list prices higher at first? Such a discount pricing can make consumers more willing to purchase discounted items if the consumers think that an expensive good is a high quality good (Armstrong and Chen 2012). As another example, consider a health club fee. Fitness clubs usually offer two kinds of contract: a monthly fixed fee and a fee per visit. The monthly fee often comes with a large discount, which would seem to make the clubs run a deficit given that the marginal cost is not zero and that consumers attend frequently. This puzzle can readily be explained by over-optimism about gym attendance. Della Vigna and Malmendier (2006) found that the consumers who chose a contract with a flat monthly fee attended on average 4.3 times per month; thus, such consumers should pay the higher price fee per visit than the contract. People often disproportionately focus on certain attributes of their available options (Kőszegi and Szeidl, 2013) and firms take advantage of it. These pricing patterns are sometimes called "the behavior aspects of pricing" (Rotemberg, 2008) or "behavioral pricing" (Krishna, 2009). If firms know consumer behaviors or psychology, they would apply this knowledge to pricing to extract a bigger consumer surplus.

In this paper, we observed a pricing puzzle in the Seoul retail gasoline market and try to explain it by testing various theories. In Korea, there are two kinds of gasoline stations: ones that sell both premium gasoline and regular gasoline together ("*premium*" *stations*) and the others that sell only regular gasoline ("*regular*" *stations*). Because gasoline is a supremely homogeneous good, there should be no price differential between the premium and the regular stations for the same grade gasoline if any characteristics of stations or the competition factors are the same. However, we found that the price differential of regular unleaded gasoline at the premium stations continued to exist even if various factors, such as product differentiation, brand/station effects, and spatial competition, are controlled.

To explain the pricing puzzle, we suggest the salience theory developed by Bordalo *et al*. (2013) and propose that the premium stations set the price of regular gasoline high to make consumers regard the price of premium gasoline to be relatively cheap, given its supposed quality (the *quality salience*), to encourage them to purchase more premium gasoline.

The remainder of this paper is organized as follows: in Section 2, we briefly explain the features of the Korean retail gasoline market and introduce the pricing puzzle we found. The model and data we use are introduced in Section 3 and we test whether the gap disappears by controlling for the various factors that can generate a price gap in Section 4. In Section 5, an alternative theory, quality salience, is discussed and we summarize and address the limitations of this study in the final section.

2. Korean retail gasoline market and pricing puzzle

There are four domestic oil refinery companies, SK Energy, GS Caltex, Hyundai Oilbank, and S-Oil, and

the importers' market share for gasoline, diesel, and kerosene was only 5.32% in 2013. The number of gas stations has increased and peaked at 13,239 in 2012. In the US, gasoline retailers typically offer gasoline in three grades: regular, mid-grade, and premium. Mid-grade gasoline is produced by mixing regular and premium and its octane level ranges from 88 to 90 AKI (Hasting and Shapiro, 2013). However, in Korea, retailers are not allowed to mix gasoline; thus, they sell only regular (91-93 RON) and premium (99+ RON) gasoline.[1] Most stations are branded while only 8.6% of the stations are unbranded (Korea Petroleum Association 2014).[2]

During our sampling period, 38% of stations were premium stations, which are mostly branded and located in high-income residential areas or downtown. The share of gas stations in Seoul, the biggest city in Korea, is only 4.6% of the total, but about 45.7% of premium gasoline is sold in Seoul. The weekly average prices of regular gasoline by premium and regular stations in Seoul are graphed in Figure 1. We can see that the price gap between premium and regular stations has a persistent and even increasing trend. In April 2008 (week 16, 2008), the price differential was about 40 KRW per liter, but the gap increased to 140 KRW by April 2014 (week 16, 2014). Why does such a price gap exist?

The retailers are not allowed to provide mid-grade gasoline with various octane ratings. They have also regulated to sell only unleaded gasoline by law since 1993. Thus, there is no quality difference in the regular gasoline sold at the premium and regular stations. An immediate attempt to explain the gap will be comparing the demand conditions that the stations face. In areas where there are more customers with low price elasticity, more stations will charge higher price and they are more likely to carry premium gasoline. The second theory is the difference in perceived quality of the stations. Consumers may care about the ancillary facilities, such as the car-wash, convenience store, and auto repair, or they may perceive that gasoline quality of one brand is better than the others. Market power could be another factor that affects both sales of premium gasoline and the price of regular gasoline. The market power of a station stems from its location or low competition and the station with higher market power can extract consumer gains by charging higher price as well as inducing the consumers to purchase premium gasoline. High prices may also reflect high costs. We will test whether the price gap disappears when these factors are controlled with panel data on prices and characteristics of the stations.

3. Model and data

3.1. Baseline model

The objective of this paper is to explain the gap in regular gasoline prices between the premium and regular stations. To do this, we set up a simple baseline model, as follows:

[1] There are various measures of octane level: Research Octane Number (RON), Motor Octane Number (MON), Anti-Knock Index (AKI) or (R+M)/2 are the widely used ratings. We do not discuss the octane ratings in detail here but note that MON is 8-12 lower than RON and AKI is the mean of RON and MON so that AKI is 4-6 lower than RON. That is, premium gasoline in the US with 94 AKI is equivalent to gasoline with 99-100 RON in other countries.

[2] The shares of branded stations: SK Energy 33.2%, GS Caltex 24.1%, Hyundai Oilbank 18.2%, and S-Oil 15.7%.

$$P_{it} = \beta_0 + \beta_1 PS_{it} + Week_t \Gamma + \varepsilon_{it} \quad (1)$$

where P_{it} is the regular gasoline price of station i at time t and PS_i is a dummy variable of which the value is 1 if station i is a premium station. The price variable is a weekly average and the set of week dummy variables, $Week_t$ is included to control for time-varying unobservable factors. The last term ε_{it} is the idiosyncratic error, which follows a normal distribution. In this baseline model, an estimate for the coefficient β_1 shows the price differentials between the premium and regular stations. We will see if this coefficient becomes indifferent from zero when we add the variables that possibly affect gasoline price.

3.2. Data

The data used in this paper came from various sources. We collected the data on gasoline stations operating in Seoul from the Opinet.[3] Opinet, the *Oil Price Information Network*, was introduced by the Korean National Oil Corporation in April 2008 to provide price information to consumers. The transaction price of every station is collected through credit card payment systems when consumers purchase fuel and the information is listed on the web and a mobile application. The Opinet data also provide each station's location and available services, such as full-service, car-wash, auto-repair, and convenience store. We assume that consumers prefer to buy gas near their home and two proxies for district-specific demand shifters were used in the estimation: the number of registered vehicle and house prices[4]. The former was collected from Statistics Korea and the latter from the Korea Appraisal Board. As a cost factor, the appraised land prices are collected from the Onnara Real Estate Information Portal (onnara.go.kr), which is operated by the government.

The descriptive statistics are shown in Table 1. The average regular gasoline price per liter was 1,884 KRW or 1.77 USD, but the regular gasoline price at premium stations was about 79.09 KRW higher than in regular stations. Among all fueling stations in Seoul, 38% were premium stations, 14% have self-service pumps, and 62% have car-wash machines. One can see that the premium stations offer more amenities and tend to be located in areas with higher demands and costs. Thus, these difference in station characteristics, demand and cost between the premium and regular stations, could be factors that explain the price gap. In terms of competition, regular stations have only slightly more competitors nearby.

4. Testing theories explaining the price gap

4.1. Product differentiation and brand effects

Because gasoline is a very homogeneous good, gasoline stations often try to make a quality difference by offering services to mitigate the price competition (Shepard 1991). Generally, additional facilities, such as full-service, car wash, auto mechanic, and convenience stores, are considered to be the vertically

[3] See Lee (2015) for the more detail information on the Opinet.
[4] Seoul consists of the twenty-five districts (called "gu").

differentiating factors that induce consumers willing to pay more. Thus, these station characteristics were added to the baseline model to test whether product differentiation explained the price differential.

Second, we consider brand effect as a cause of price differentials. If consumers perceive the gasoline sold at unbranded stations to be a low quality good, then branded stations would raise their price (Pennerstofer 2009). As we can see in Table 1, the share of unbranded stations among the regular stations is higher than among the premium stations. Thus, there is a possibility that the low share of unbranded stations causes the price differential.

Table 2 shows that the price of regular gasoline increases when full-service, car wash, and auto-repair services are available in a station, while the price decreases when there is a convenience store. We can also see that the price is higher in the branded stations. However the price differential is still significant and positive even if the station characteristics and brand dummies are controlled, although the price gap is slightly reduced as more control variables are added to the regression.

4.2. Spatial competition

We can consider carrying premium gasoline as vertical differentiation or product proliferation and thus take different market structure as a potential determinant of the price gap. There is an extensive literature about the impact of competition on quality choice, but the studies have not reached a conclusion on whether competition spurs or discourages adoption of high-quality products (e.g. see Reinganum, 1981; Kessler and Geppert, 2005; Berry and Waldfogel, 2010). In the retail gasoline market, it is possible that the stations in less competitive markets possess the power to charge higher prices and have incentives to vertically differentiate by selling premium gasoline with less risk of being challenged by low-price rivals.

If the price gap is caused mainly by market structure, it will disappear when the factors concerning competition are controlled. Degrees of competition depend on the definition of market and potential competitors. Thus, we would conduct the analysis with various competition measures, such as the number of competitors in a 3.5-km radius (Barron *et al*., 2004; Lewis, 2008), the spatially weighted share of unbranded stations (Pennerstorfer, 2009), and distance to the closest gas station.

The estimation results are reported in Table 3. The competition factors intuitively explain the pricing behaviors of stations. The number of competitors and spatially weighted share of unbranded stations reduce the price level due to intensified competition. The gasoline price at a gas station also decreases if another station is nearby. However, the price differential remains significant although the size of the differential is reduced.

4.3. Demand and cost shifters

If the premium stations are located in an area with high demand for quality as well as quantity, then they can sell regular gasoline at a higher price. In particular, consumers with higher incomes would have a higher willingness to pay for regular gasoline and a larger demand for premium gasoline (Gabszewicz and Thisse, 1979). To control the income effect, Barron *et al*. (2000) used the median income, calculated using the ZIP

code, but unfortunately we do not have data on district-level income. Instead, we used the average transaction price of apartments in each district. In Korea, the apartment is a very popular housing type and its price is closely related to the income of the residents living in the districts. We also include the number of cars per household in a district as an additional control variable for demand.

Another potential reason for the price gap is cost differential. Marginal costs including wholesale gasoline prices and labor costs should not be very different across stations, but land prices may. Usually fixed costs do not affect price decisions but interest or rent burden can be different if the land price varies. Figure 3 shows that 75% of districts with the highest share of the premium stations overlapped with the districts with the highest average land prices. Thus, the higher price of regular gasoline in the premium stations could reflect higher costs.

The estimation results in Table 3 show that greater demand and costs indeed lead to higher gasoline prices, but the price differential is still present.

4.4. Other unobserved effects

There may be other unobserved station-specific factors that consumers observe but researchers do not. Premium gas stations may have a larger space, kinder staff, promotions, or any gifts to attract consumers for premium gasoline, and these factors could increase the consumers' willingness to pay and allow the premium stations to set higher regular gasoline prices. To control these factors, we re-estimate the equation with demand and cost factors (the third column in Table 3) using the station fixed effects. According to the estimation result in the last column, when considering the station fixed effects, the price gap between the premium and regular stations decreased, from 49.54 to 33.13 KRW per liter, but was still statistically significant.

4.5. Local market

The previous results on price differentials so far have used average levels in the Seoul retail gasoline market. As mentioned, however, the retail gasoline market is locally competitive. Thus, we wanted to investigate whether the price gap existed in a narrowly defined market. To do this, we defined the markets of three sizes – 0.5, 1, and 3.5 km radii – then, we calculated the average price differentials in the local markets and used it as a dependent variable. We set up a regression model similar to Shepard (1991), as follows:

$$\Delta_{jt} = \bar{P}_{jt}^{p} - \bar{P}_{jt}^{r} = \Delta X_{jt}'\beta + u_{jt} \quad (2)$$

where $\bar{P}_{jt}^{p}$ is the average price of regular gasoline being sold at the premium stations in a market j; $\bar{P}_{jt}^{r}$ is the price at the regular stations; ΔX_{jt} is the vector including the station characteristics and land price of stations in market j; and u_{jt} is the error term. In equation (2), we excluded the time dummies, the competition factors, and the demand factors, because these variables are invariant with time and constant in

each area (Shepard, 1991).

The estimation results are reported in Table 4. The mean of Δregular gasoline price is decreased as the market radiuses are decreased. The constant denoting the price differentials remains to have positive and statistically significant values, which range from 9.07 to 30.04 KRW per liter.

4.6. Station type change

Another way to eliminate unobserved station-specific effects would be to compare the price before and after a station changes its type from premium to regular or vice versa. If a station strategically increases the price of regular gasoline as a premium station, then the price in that station will go up after it starts to sell premium gasoline. Fortunately, we did observe some stations in our sample changing from premium to regular or from regular to premium. As seen in Figure 4, the share of premium stations had increased before 2011, but it decreased since then. Thus, we can test whether there were price changes along with the type change of the stations using the following equation.

$$P_{it} = \beta_0 + \beta_1 D_{it}^{r\to p} + \beta_2 D_{it}^{p\to r} + \beta_3 SS_i + X_{it}\delta + Week_t\Gamma + \varepsilon_{it} \quad (3)$$

where $D_{it}^{r\to p}$ denotes the dummy variable having value one if a regular stations changes to a premium station, $D_{it}^{p\to r}$ denotes the dummy variable having value one if a premium station changes to a regular station, X_{it} is the vector of the control variables, and other variables are the same as in equation (1). For control variables, we used all the variables used in the cost effects model in Table 3.

Each coefficient in equation (3) indicates the average price of regular gasoline along with the each station's type. If any station changes in type from regular to premium gasoline station, then the expected price differential of such stations is $\Delta^{r\to p} = \beta_1$, and the expected price change in the stations that changed from premium back to regular stations is $\Delta^{p\to r} = \beta_2$. The estimation results are reported in Table 5. In the second column, which includes the control variables, we find a price rise by about 45.52 KRW after stations change their type from regular to premium stations, whereas there is a price decrease by 29.25 KRW after they stop selling premium gasoline. An interesting fact we found is that the stations that had changed from regular to premium decrease the regular gasoline price when they went back to regular stations and they charged less than the stations that continued to be regular stations. This may happen because the stations that failed with premium price strategy then more aggressively tried to attract their lost customers.

5. Salience theory: a discussion

So far, we have tried to explain the price gap of regular gasoline between the premium and regular stations with various theories, but the gap has not disappeared. In this section we propose and discuss a conjecture, the quality salience, developed by Bordalo *et al*. (2013). The *salience* in salience theory refers to as "*the phenomenon that when one's attention is differentially directed to one portion of the environment*

rather than to others, the information contained in that portion will receive disproportionate weighting in subsequent judgments" (Taylor and Thompson, 1982). Salience effects so far have been studied in psychology through the experiments, but Bordalo *et al*. (2013) applied it to economics through a theory model.

To apply salience theory to the pricing puzzle, assume that there is a locally monopolized gasoline station and some identical consumers. Because the gasoline station monopolistically competes with other stations, it has some power in pricing unlike under perfect competition (Wolinsky, 1986). This station sells two goods of which the quality and price differ. Let the quality of the high quality good (premium unleaded gasoline) be q_h and the quality of the low quality good (regular unleaded gasoline) be q_l. Assume that the following conditions hold: $q_h > q_l$, and $p_h > p_l$. If consumers are rational and a utility is assumed $u_k = q_k - p_k$, $k \in \{q, l\}$, then the consumers will choose the a good that gives $u^* = \max\{u_q, u_l\}$. However, if $u_q = u_l$, which good is chosen? According to the salience theory, consumers choose the more salient good in terms of quality or price in such a case. The essential features of salience theory are as follows: if the premium gasoline's quality to price ratio is higher than the regular gasoline's, i.e., $q_h/p_h > q_l/p_l$, then consumers choose the premium gasoline, because in this case the quality is more salient, and otherwise, regular gasoline is chosen, because the price is more salient.

Now consider the situation where price is salient i.e. $q_h/p_h < q_l/p_l$. In this case, how should a gas station make a consumer consider quality salient? A seller can make the quality-price ratio as $q_h/p_h > q_l/p_l$ by dropping p_h, or raising p_l. If changing price is not easy, the seller can reverse the ratio by increasing the markup, i.e., $q_h/(p_h + \Delta p_h) > q_l/(p_h + \Delta p_h)$.

In the Korean retail gasoline market, gasoline with an octane level above 94 is graded as premium, and one with an octane level between 92 and 94 is regular. According to the survey of Opinet, the octane levels of premium and regular gasoline sold in the Korean market are, on average, 103.2 and 92.2, respectively. These figures mean a 1.119 quality ratio. In Figure 2, we can see that the price ratio stayed lower than the quality ratio before 2013. According to the salience theory, premium stations may have kept the price of their regular gasoline low to make quality salient and to sell more premium gasoline.

6. Summary and Limitations

In this paper, we sought to investigate a pricing puzzle, namely the price gap of regular unleaded gasoline between the stations that sell both premium and regular gasoline and the stations selling only regular gasoline in the retail gasoline market. We empirically tested various potential determinants, such as demand, costs, and station-specific characteristics, but the gap was not fully explained. Also, we find that when regular stations change their station type to a premium gasoline station, they set the price of regular gasoline higher, and when they go back to being a regular gasoline station, they cut the price of regular gasoline.

We proposed salient pricing as a candidate theory. However, we have not yet demonstrated that the premium stations charge higher price for regular gasoline to make quality salient and to sell more premium gasoline due to some limitations currently. To verify whether the salience theory works here, we have to

compare the share of sales of premium gasoline with regular gasoline and see how consumer demand reacts to the quality and the price of gasoline. However we currently do not have sales data at the station level. In this paper, therefore, we can only conclude that we have found an interesting phenomenon about the pricing and that salience theory may be able to explain it.

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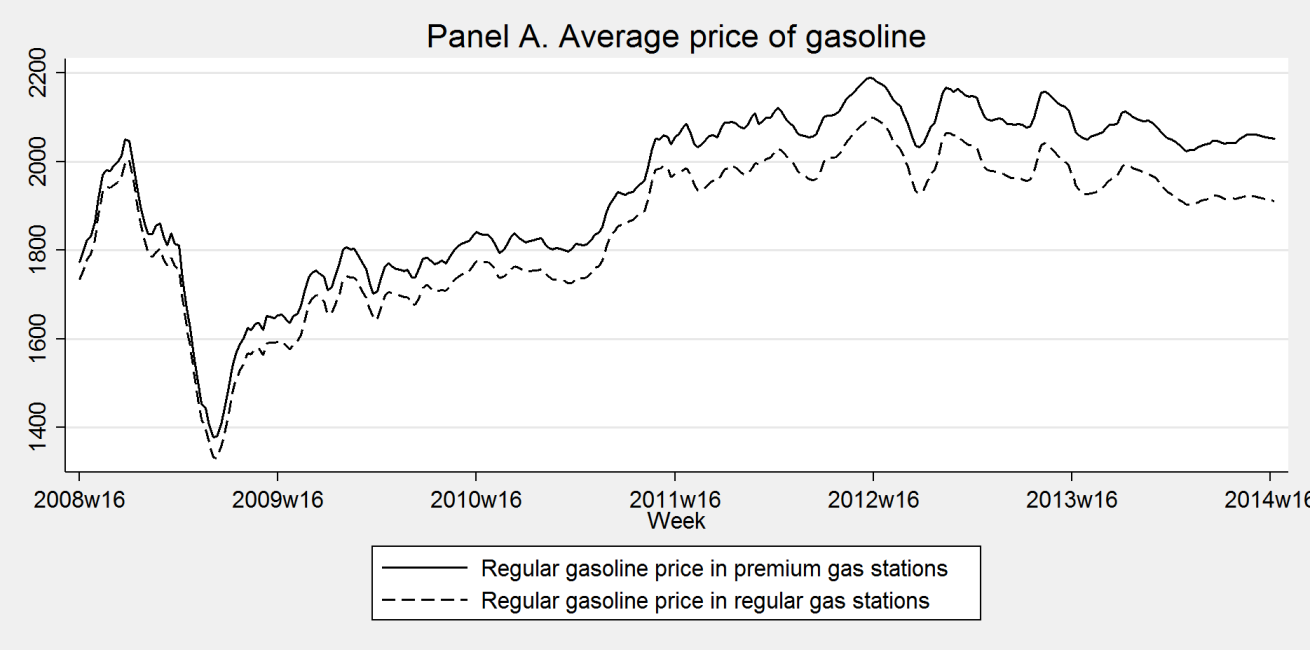
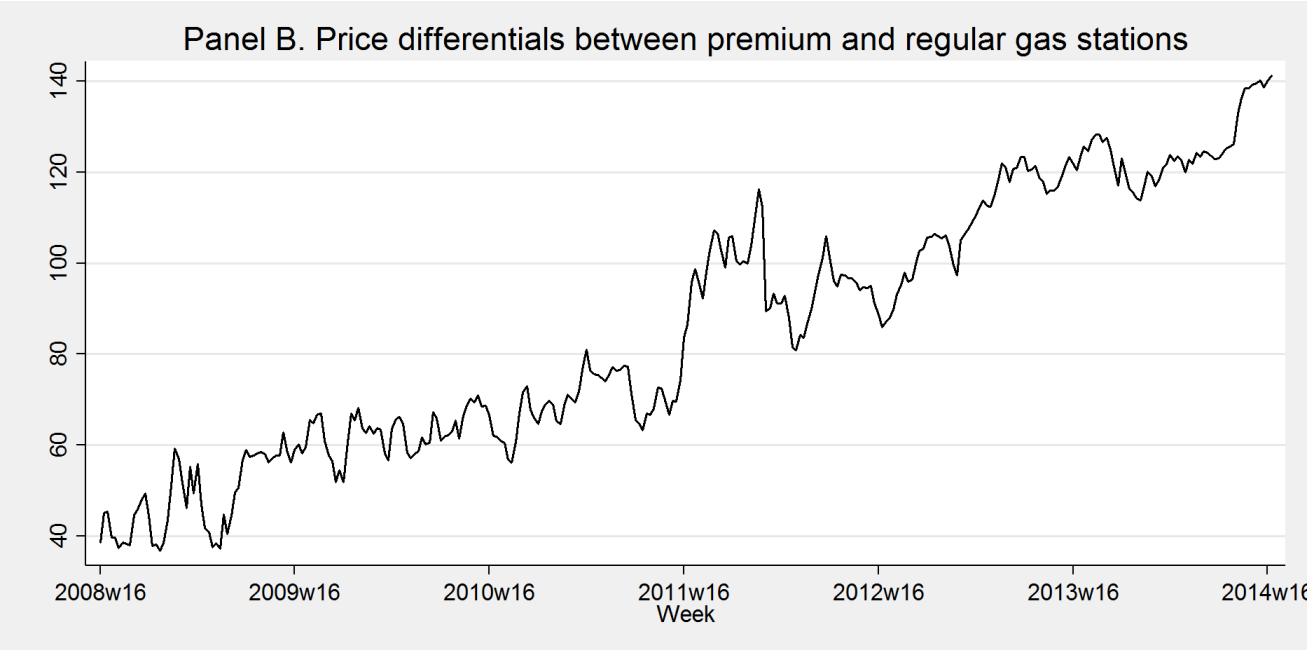
Figures and Tables

Figure 1. Trends in regular gasoline price in Seoul





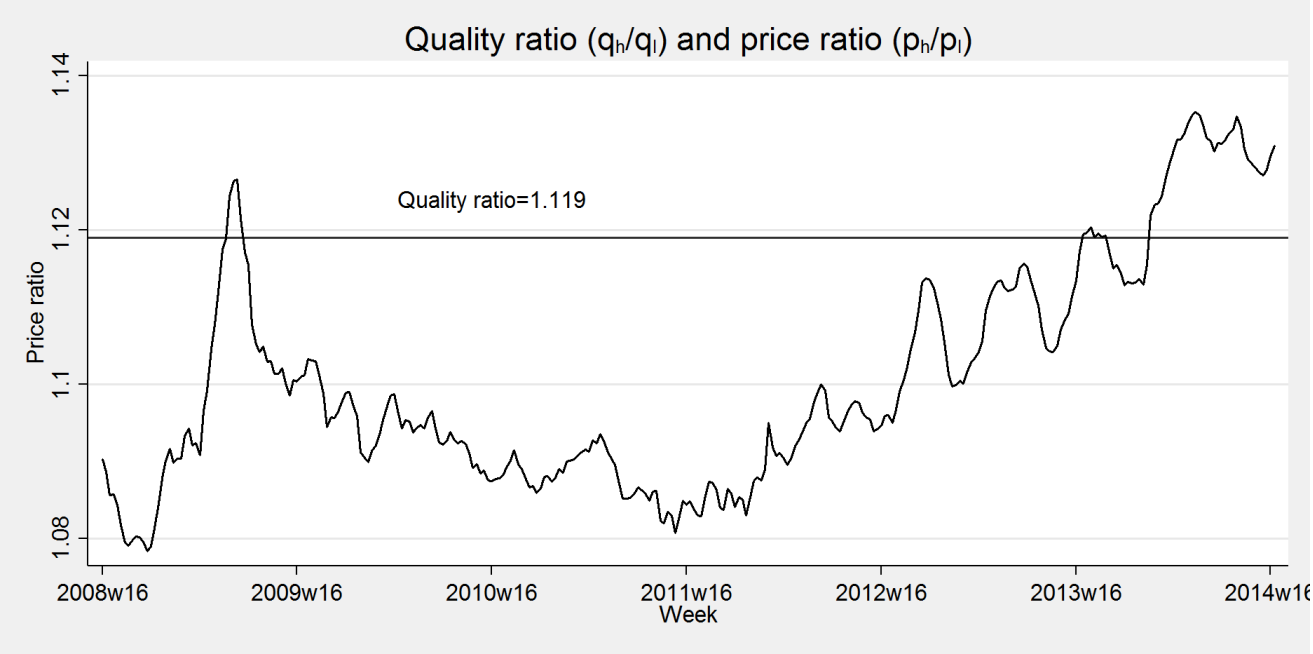
Source: Korea National Oil Corporation

Table 1. Descriptive statistics

Variables	Gasoline stations in Seoul		Premium gasoline stations		Regular gasoline stations	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Regular gasoline prices (KRW/liter)	1,884.75	196.82	1,933.56	212.74	1,854.47	179.72
Premium gasoline station	0.38	0.49				
Product differentiations						
Self-service	0.14	0.34	0.16	0.36	0.12	0.33
Car wash	0.62	0.48	0.75	0.43	0.55	0.50
Auto mechanic	0.27	0.44	0.34	0.47	0.22	0.41
Convenience store	0.10	0.30	0.17	0.37	0.06	0.23
Brand						
SK Energy	0.42	0.49	0.52	0.50	0.36	0.48
GS Caltex	0.28	0.45	0.37	0.48	0.22	0.41
Hyundai Oilbank	0.14	0.34	0.05	0.22	0.19	0.39
S-Oil	0.12	0.32	0.04	0.21	0.16	0.37
Unbranded	0.04	0.20	0.01	0.09	0.06	0.24
Competition						
No. of competitors in a 3.5-km radius	44.59	14.31	44.33	13.64	44.75	14.71
Spatially weighted share of unbranded stations in a 3.5-km radius	0.03	0.04	0.02	0.03	0.04	0.05
Distance with closest station (km)	0.40	0.26	0.40	0.26	0.40	0.26
Demand						
# of cars per household in district	0.73	0.19	0.81	0.21	0.68	0.15
Value of housing in district (1,000 KRW/m^2)	6,255.65	2,246.35	7,363.02	2,549.21	5,568.69	1,706.61
Cost						
Land prices (1,000 KRW/m^2)	5,513.89	3,435.09	6,967.78	4,482.42	4,611.96	2,128.62
Observations	192,691		73,772		118,919	

Sources: Korea National Oil Corporation, Statics Korea, Korea Appraisal Board, Onnara Real Estate Information Portal

Figure 2. Trends of quality and price ratio



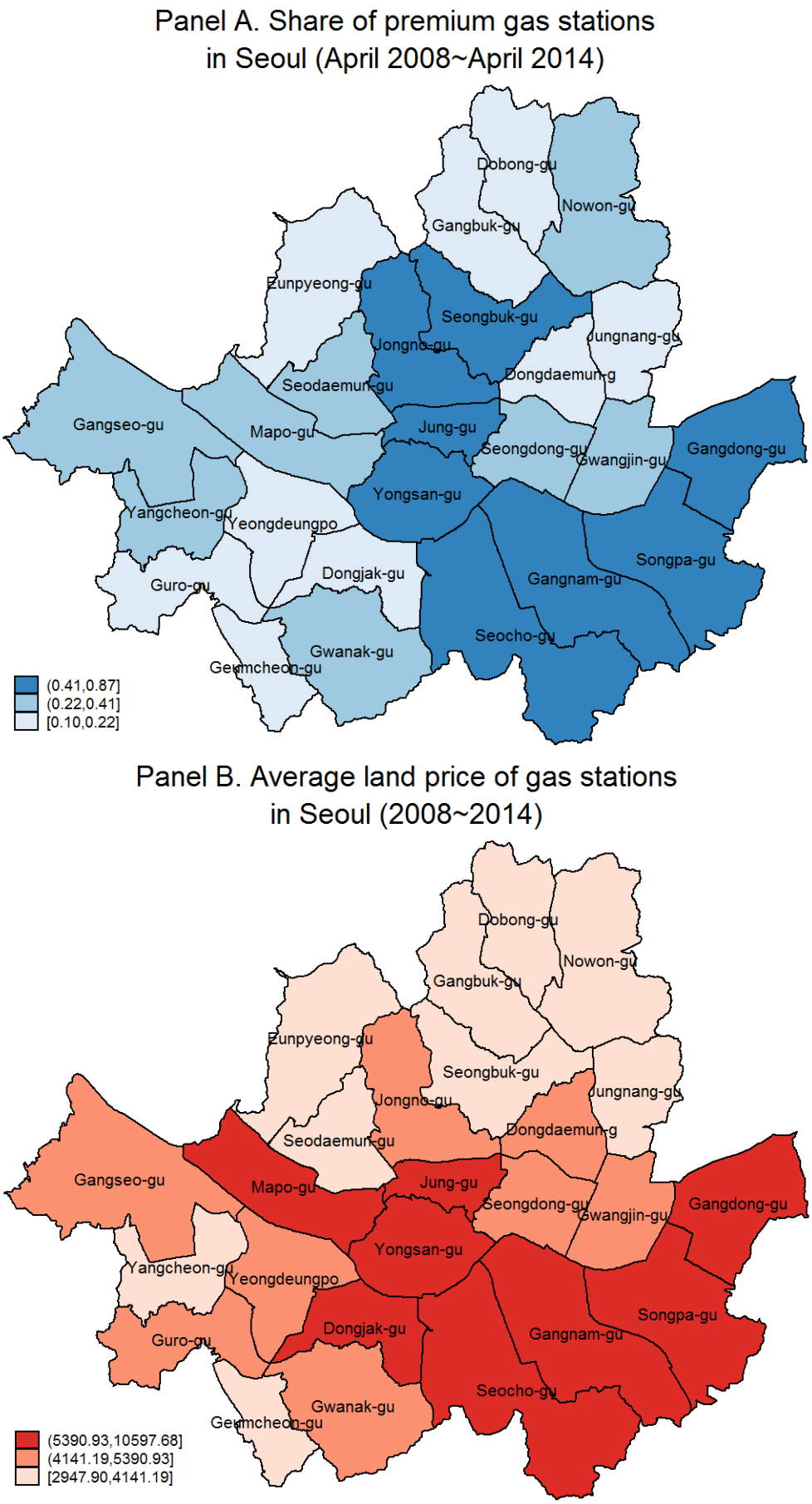
Note: The qualities of premium and regular unleaded gasoline in Korea are 103.2 and 92.2 octane, respectively.
Source: Korea National Oil Corporation

Table 2. Price differentials of regular gasoline between premium and regular gasoline stations when product differentiation and brand effects are controlled

Dependent=regular gasoline price	Baseline regression	Product differentiation	Brand effects
Premium gasoline stations	86.65	84.13	74.72
	(194.60)	(185.12)	(162.25)
Self-service stations	-56.64	-59.41	-63.67
	(-106.45)	(-108.41)	(-116.52)
Car wash		14.59	9.26
		(33.16)	(21.62)
Auto mechanic		3.40	2.69
		(6.57)	(5.31)
Convenience store		-6.71	-11.20
		(-9.36)	(-15.70)
SK Energy			90.11
			(129.79)
GS Caltex			60.29
			(84.18)
Hyundai Oilbank			41.05
			(55.58)
S-Oil			53.97
			(67.28)
Constant (Regular gasoline stations)	1725.51	1717.61	1655.86
	(705.07)	(706.69)	(690.57)
R^2	0.80	0.80	0.81
Observations		192,691	

Notes: All variables are statistically significant at 1%. t-statistics in parentheses. All models include the week dummies. A dummy for unbranded station is omitted.

Figure 3. Share of premium gasoline stations and average land price in Seoul



Sources: Korea National Oil Corporation, Onnara Real Estate Information Portal

Table 3. Price differentials by spatial competition, demand effects, fixed cost effects, and unobserved effects

Dependent=regular gasoline price	Spatial competition	Demand effects	Cost effects	Fixed effects
Constant (Regular gasoline stations)	1667.40	1448.13	1405.73	2331.39
	(657.04)	(201.01)	(195.61)	(4.67)
Premium gasoline stations ($\Delta = P^p - P^r$)	63.96	50.89	49.54	33.13
	(143.96)	(111.34)	(108.39)	(3.95)
Self-service stations	-64.16	-58.02	-57.33	-71.60
	(-119.94)	(-112.34)	(-110.46)	(-6.66)
Car wash	11.25	10.22	10.47	
	(27.08)	(25.11)	(25.84)	
Auto mechanic	3.11	1.39	0.44	
	(6.30)	(2.89)	(0.91)	
Convenience store	-10.40	-5.75	-6.46	
	(-15.01)	(-8.53)	(-9.55)	
SK Energy	84.11	84.75	81.96	64.63
	(118.78)	(122.37)	(117.65)	(5.17)
GS Caltex	51.71	52.46	49.61	48.56
	(70.69)	(73.15)	(69.21)	(3.64)
Hyundai Oilbank	32.93	34.87	31.67	9.15
	(43.97)	(47.49)	(42.52)	(0.61)
S-Oil	47.39	49.17	46.48	-20.23
	(58.69)	(63.23)	(60.22)	(-0.97)
# of competitors in a 3.5-km radius	-0.07	-0.15	-0.23	-1.14
	(-5.18)	(-11.34)	(-17.44)	(-2.36)
Spatially weighted share of unbranded stations in a 3.5-km radius	-439.34	-379.92	-347.65	-158.08
	(-117.22)	(-102.23)	(-94.14)	(-4.45)
Distance with closest station	17.76	15.92	18.29	13.31
	(24.48)	(22.00)	(25.46)	(1.18)
# of cars per household in district		67.83	64.27	-228.43
		(41.96)	(40.24)	(-9.78)
ln(Value of housing in district)		20.33	11.41	-58.36
		(23.17)	(12.42)	(-1.05)
ln(Land price of station i)			15.09	10.07
			(35.12)	(0.60)
R^2	0.82	0.83	0.83	0.92
Observations	192,691			

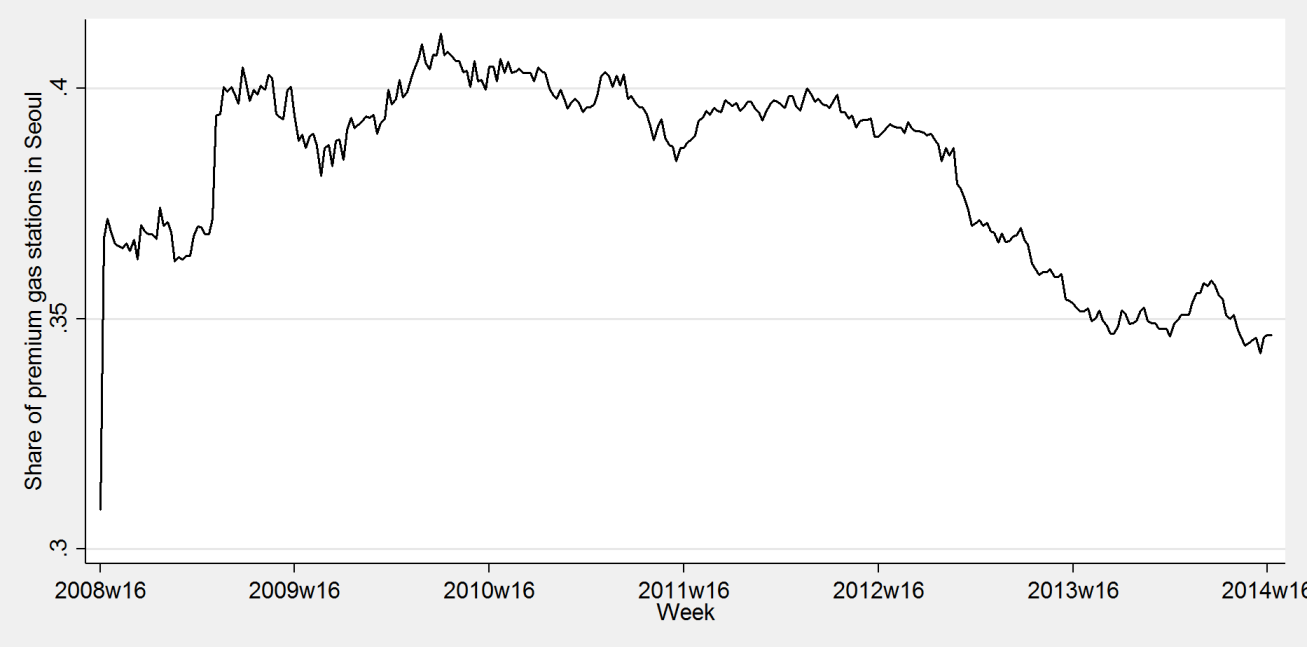
Notes: The most of variables are statistically significant at 1%. t-statistics in parentheses. All models include the week dummies. In the fixed effects model, Car wash, Auto mechanic, and Convenience stores are omitted due to the station fixed effects.

Table 4. Local market regressions

Dependent=Δregular gasoline price	0.5km	1km	3.5km
Constant ($\Delta = P^p - P^r$)	9.07	34.96	30.04
	(6.65)	(69.67)	(47.08)
ΔCar wash	34.79	24.74	-3.15
	(24.00)	(31.83)	(-1.92)
ΔAuto mechanic	7.60	-5.95	-14.11
	(4.50)	(-5.69)	(-9.16)
ΔConvenience store	15.96	-18.39	6.66
	(7.76)	(-16.74)	(4.05)
ΔSK Energy	-17.60	31.22	52.42
	(-2.30)	(17.16)	(14.53)
ΔGS Caltex	-68.57	11.44	-3.30
	(-9.00)	(6.07)	(-0.85)
ΔHyundai Oilbank	-94.56	-19.84	-65.85
	(-12.30)	(-10.04)	(-17.70)
ΔS-Oil	-86.36	-15.72	-79.72
	(-10.85)	(-7.51)	(-19.50)
Δln(Land price of stations)	-30.89	-2.41	90.42
	(-9.17)	(-2.98)	(92.87)
R^2	0.18	0.10	0.25
Mean of Δregular gasoline price	37.14	48.69	72.27
S.D. of Δregular gasoline price	[95.47]	[79.97]	[49.87]
Observations	10,808	43,427	73,724

Notes: Most of variables are statistically significant at 1%. t-statistics in parentheses.

Figure 4. Trends in the share of premium gasoline stations in Seoul



Sources: Korea National Oil Corporation

Table 5. Before and after analysis along with the type change of gasoline stations

Dependent=regular gasoline price	Baseline	Full
Constant	1726.03	1399.17
	(710.77)	(195.90)
Regular gasoline stations → Premium gasoline stations	84.60	45.52
($\Delta^{r\to p} = P^p(t) - P^r(t-1)$)	(188.52)	(99.40)
Premium gasoline stations → Regular gasoline stations	-17.58	-29.25
($\Delta^{p\to r} = P^r(t) - P^p(t-1)$)	(-23.70)	(-41.85)
Self-service stations	-55.69	-55.92
	(-103.99)	(-107.68)
Car wash		11.36
		(28.12)
Auto mechanic		0.61
		(1.27)
Convenience store		-6.65
		(-9.85)
SK Energy		82.57
		(120.30)
GS Caltex		49.61
		(70.00)
Hyundai Oilbank		31.74
		(43.02)
S-Oil		47.87
		(62.96)
# of competitors in a 3.5-km radius		-0.26
		(-19.29)
Spatially weighted share of unbranded stations in a 3.5-km radius		-351.97
		(-95.10)
Distance with closest station		16.99
		(23.64)
# of cars per household in district		64.89
		(40.86)
ln(Value of housing in district)		11.45
		(12.54)
ln(Land price of station i)		15.97
		(37.33)
R^2	0.80	0.83
Observations	192,691	

Notes: All variables are statistically significant at 1%. t-statistics in parentheses. In the case of the full model, other variables used in the fixed-cost model in Table 3 are included as the control variables. All models include the week dummies.