DOES ACCESIBILITY AFFECT RETAIL PRICES AND COMPETITION? AN EMPIRICAL APPLICATION[1]

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Abstract

This paper attempts to link the concepts of accessibility and company behaviour within the markets, by empirically testing the hydrocarbon retail market in one Spanish autonomous region. We use a database that includes sale price, service station location, level of traffic and type of road. We statistically and econometrically demonstrate that accessibility has two contrasting effects on final prices, and that the negative effects of less accessibility and higher prices dominate. Nevertheless, if we include the value of time, then no rational consumer should travel further than his nearest petrol station in search of lower prices. Finally, our paper shows that service stations can establish a dominant position, if consumers don't have access to other points of sale with a six minute radius.

Keywords: Accessibility; Location; Petrol stations; Oligopoly.

J.E.L. Classification: R40; L13; L81.

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1. Introduction

Accessibility is a widely used concept in many spheres of transport economy. During the last forty years it has become increasingly used as a reference in the fields of planning and transport policies. Increasing the levels of accessibility has now become a common objective for these plans (van Wee *et al.*, 2001)[4].

In general terms, accessibility measures the ease of reaching valued destinations, and there are various methods for measuring it within a region; see Handy and Niemeir (1997), Baradaran and Ramjerdi (2001), and El-Geneidy and Levinson (2006). In fact, van Wee et al. (2001) argue that these measures and applications can be categorized into three clusters, which include not only monetary aspects but also qualitative ones such as travel time, risks, comfort, etc.; these are infrastructure related, activities related and mixed measures. The first one focuses on the characteristics of infrastructure and their use, the second is related to activities such as living, working, recreation and shopping, and the last one is a mix of both activities and infrastructures; e.g. distances between dwellings or industrial areas and bus stops, etc.

Traditional transport planning basically centred on the provision of infrastructures, since a direct relationship was assumed to exist between the amount of infrastructure and welfare; i.e. the greater the level of infrastructure, then the easier, cheaper and faster travelling would be, which would consequently be better for the users and society in general. However, this premise could bring about a vicious circle with considerable long term environmental repercussions. Better infrastructure could mean more distant locations that promote the use of the car, which in turn require better infrastructure.

A similar idea happened in the relationship between the retailer and accessibility. Kaufman et al. 1977, illustrate this relationship. The authors carry out a study in the United States of America on the relationship among food prices in different types of

[4] Handy 2002, asserts that references to accessibility feature in most US transport plans, and that its improvement is a constant objective.

establishments, and their accessibility in terms of family incomes. The authors demonstrate how low income families with reduced probability living in the vicinity of supermarkets may have to buy the same highly priced products as families with greater purchasing power. Along the same lines, a 1991 paper by MacDonald and Nelson demonstrates that the prices for a basket of given goods are 4% lower in suburbs than in city centres. By using a database holding the locations of fast food restaurants Stewart and Davies (2005) determine how differences in location affect their final prices.

These examples show that accessibility can be analyzed, not only from a direct transport economy perspective, but also from how the access facility generates opportunities for individuals in terms of improving their employment prospects; see van Wee *et al.* 2001, Srour *et al.* 2002 and Franklin and Waddell 2003. For price variation of goods such as housing, see El-Geneidy and Levinson, 2006; and for the possibilities when locating new sales outlets, see Ritseman van Eck and de Jong, 1999.

In this latest typology of studies, decisions on company location and behaviour will be seen to be affected just as much by accessibility as by other diverse factors, such as the characteristics of the product or service, the market structure and product differentiation (De Palma *et al.*, 2006).

By taking this fact into account this paper attempts to demonstrate the direct relationship between accessibility and the level of competition in a specific market. To do so we focus our study on a sector with outstanding importance for any economy, the retail consumption of petroleum products. Graddy (1997) suggests that retailers carry out "unfair" commercial practices in low income city centres and in areas that are far from large urban centres. This contradicts the idea of the location objectives for a new business. According to van Wee *et al.* (2001), "(…) the central areas of big cities and towns seem to be the most attractive locations".

Nevertheless, the retail petrol sector is more closely linked to Graddy's results than to those of van Wee *et al.* This is due to one fundamental reason, the possibility that the retailers in remote areas, with poor access and/or a low average intensity of vehicles have of exploiting their geographically dominant position. Hydrocarbon consumption is unlikely to be a programmed decision; that is if the need to acquire petrol, it can't be postponed. Petrol stations can take advantage of this situation by applying high prices, they may even

create "social exclusion", if we consider petrol to be a "basic need". This is more serious for car users in remote areas where public transport isn't normally as frequent as in city centres.

Along different lines Frankel and Gould (2001) state that family income and prices in the USA are equally related. Nevertheless, their model doesn't explain if the variability in the results is due to differences in consumer behaviour, company costs or differences in the characteristics and quality of services among the shops.

In contrast to other papers where the objective was to locate new points of sale[5], this study tries to determine the behaviour of established companies by using prices. Hence, it is not necessary to assume, as van Wee *et al.*, 2001 do, that the nearest demand will be displaced to this new location. It assumes that traffic, the type of road and the services provided also determine behaviour[6].

The study is based on the concept of gravitational models. There are two types, depending on the distance function that is used, and on the constraints on the numbers of customers from each area and at each shop. Nevertheless, these applications are analysed while taking a threshold value into account; for example, the number of workers that can be found in fixed location, in a forty-five minute radius by car. This concept is one of the ideas that we use in our objective of determining the affect of the probability of finding a cheaper petrol station within a certain time period, while considering the road's characteristics. This objective will also analyze companies within the market, from a behavioural perspective. It will see how they take advantage of the problems of accessibility to behave less competitively than points of sale with better access to other competitors. The characteristics of the road and population and other factors should also be borne in mind.

With this aim, and after this introduction, this paper is structured as follows. In Section 2 we present the data used for the empirical application and the main descriptive statistics,

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[5] See Clarke 1997, for a summary of the use of Geographic Information Systems (GIS).

[6] Following Birkin *et al.* (1996, p 39), we can consider it as "dominant store" analysis.

which we develop and resolve econometrically in Sections 3 and 4. Finally, in the fifth section we show the paper's main conclusions, and link the level of consumer accessibility to the petrol stations to the behaviour of the market's players.

2. Data

The Spanish hydrocarbon market has undergone various gradual changes during the last twenty years, both at wholesale and retail levels. Basically, it passed from being a state run monopoly run by CAMPSA, now Repsol, to liberation of prices and general supply, although it is currently characterized at all levels by notable degrees of concentration[7].

The improvements in the global supply of land transport infrastructures, which are linked to this process, have not enabled Spain to achieve the same indicators as in the rest of the European Union. This is despite the transport network being dominated by road usage, both for people and merchandise; see Campos and de Rus, 2002. Between the 1970s and the 1990s Spain reduced its average per capita funding, in spite of the aforementioned global increase in the level of infrastructures.

To summarize, in absolute terms the development of infrastructure through more and better roads, and the possibility of reaching a more favourable situation with petrol, the sector's most important input market, mean it is possible to positively influence the levels of accessibility in advance. These should be understood as potential opportunities to achieve a determined objective; i.e. lower prices and a shorter time period for the acquisition of goods.

To better understand the relationship between the accessibility and competition infrastructure within a sector, we have compiled a database for the autonomous region of Galicia; this is an area of Spain with a high degree of both rural and urban areas. This data enables us to compare the results between the infrastructure and demand typologies. In this

[7] See Perdiguero and Borrell (2007) for a more detailed view of the sector's liberalization process, and its current situation in Spain. Alternatively, see Perdiguero and Jiménez (2008) for a differentiated regional analysis.

region, in 2007, there were 604 retail service stations representing different companies and locations. Both these factors determine market behaviour[8].

The database contains the sale price for unleaded petrol 95, set by the companies in the week 5th to 11th November 2007, and obtained from the Spanish Government's Ministry of Industry, Trade and Tourism website. As not all the service stations provided information, the database we have used to carry out contains 511 of a total of 604. The 93 service stations with missing values don't show any specific pattern, either in terms of brand or location, so we don't believe that our results will be affected. The brand and road location of each service station that provided data is also available.

Using the location of each service station we were able to allot the following demand and access facility indicators: the category of road the station is sited in and traffic intensity; these variables show a low correlation of 0.17. For the roads the classifications are: rural, urban transient, industry/office, and with a lesser presence, residential and motorway. For access, our classification uses four levels ranging from lower to higher volumes of traffic, and we have assigned them ascending numerical values: poor (1), medium (2), good (3) and very good (4). Finally, using Spain's annual abstract of statistics (Anuario Estadístico de España) for 2007 prepared by La Caixa's Research Department, we have estimated the local population; and we have calculated the international wholesale price rates for unleaded petrol 95 in the Rotterdam spot market, by using OPEC's website to calculate the gross margin.

Table 1 uses this information and shows some descriptive indicators, grouped into petrol brands. From this we can draw attention to the market structure. Three companies, the Repsol Group, Cepsa and Galp, account for over 67% of all the region's stations.

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[8] All the following data excluding prices has been supplied by Catalist (www.catalist.com), which is a company dedicated to the sale of information on the hydrocarbon sector. Annex 1 gives a more in depth explanation of some of the variables. The subsequent analysis has been carried out by the prior programming of computer codes, using the Matlab statistical program and the SAS package; these have permitted us to manage a broad database.

One item of data obtained from service station location is the distance to the other stations, in minutes, which depends on the road speed, and metres. This allows us to demarcate, for each point of sale, the possibilities for competing with the others. The data demonstrates that, apart from having a greater number of petrol stations, these three companies have an average minimum distance from other service stations, regardless of brand, which exceeds the 12.6 minute mean. As we will see in Section 5, this confers a significant advantage with respect to avoiding competition. Finally, the distribution of sales points in Galicia, both in rural and urban areas, is very similar to the average for the sector; Agip and the Repsol Group focus more on built-up than country areas.

TABLE 1: SOME DESCRIPTIVE STATISTICS (BY BRAND)

Brand	Number of retailers	Average Price	Average Traffic intensity	Average Minimun time (mins) to other petrol stations	% Petrol stations in…			
					Rural	Urban	Industry / Office	Motorway
AGIP	18	1.0957 (0.01)	2.5	9.0 (5.7)	11.1	77.7	5.6	5.6
Alcampo	2	1.0965 (0.004)	2.5	1.0 (0.4)	0	50	50	0
Avanti	2	1.0935 (0.006)	2	6.3 (5.9)	100	0	0	0
Avia	1	1.105	3	9.5	100	0	0	0
Campaño	1	1.121 (0)	3	23.7 (0)	100	0	0	0
Campsa	144	1.098 (0.004)	2.5	16.6 (15.8)	55.6	42.4	2	0
Carrefour	1	1.097	3	5.8	0	100	0	0
Ceao	2	1.085 (0.01)	3	2.3 (0.7)	50	0	50	0
Cepsa	110	1.102 (0.006)	2.6	12.0 (12.1)	67.3	27.3	4.5	0.9
Erg	12	1.094 (0.008)	2.7	8.4 (8.3)	66.6	16.7	16.7	0
Eroski	3	1.055 (0.005)	2.3	3.6 (3.2)	66.7	0	33.3	0
Ertoil	1	1.097	2	5.3	100	0	0	0
Fegoblan	1	1.101 (0)	4	6.1	100	0	0	0
Fina	3	1.098 (0.002)	2	19.5 (15.0)	66.7	33.3	0	0
Galp(*)	41	1.103 (0.019)	2.7	9.4 (7.8)	73.2	12.2	2.4	7.3
Meroil	15	1.099 (0.007)	2.2	8.3 (8.7)	73.3	20	6.7	0
Ortegal oil	3	1.098 (0)	2	16.4 (8.7)	33.3	66.7	0	0

Petronor(*)	43	1.100 (0.006)	2.5	15.1 (10.4)	67.4	27.9	2.3	0
Repsol(1)	113	1.099 (0.009)	2.8	13.0 (11.9)	59.3	28.3	8.0	4.4
Sayar	1	1.09	2	13.0	100	0	0	0
Sertuy	1	1.101	4	6.3	100	0	0	0
Shell	14	1.100 (0.009)	2.8	6.7 (4.5)	50	42.9	7.1	0
Top oil	1	1.109	3	2.7	0	100	0	0
Unbranded(*)	66	1.096 (0.008)	2.3	9.4 (8.8)	65.2	21.2	10.6	0
Valcarce	2	1.101 (0)	2.5	20.5 (11.0)	100	0	0	0
Average (or total data)(*)	604	1.099 (0.00009)	2.6	12.6 (17.5)	63.2	28.6	5.6	1.7

Source: Own elaboration from CATALIST data-base information.
(*) Some missing values are included. (1) Repsol Group are Campsa, Repsol y Petronor.

The data brings up one result that we will see in later sections. Almost 50% of the points of sale are located on roads of average intensity, and only 4% are located on low intensity roads. The greater the intensity of traffic on the road, then the higher the price of petrol 95 is. This is a clear effect of demand in each local market. For the same aforementioned motive, service stations are further apart from one another when the intensity is less. These results are shown in Table 2.

TABLE 2: DESCRIPTIVE STATISTICS (BY AVERAGE TRAFFIC INTENSITY)

Average traffic intensity	Retailers	Price	Average Minimun time (mins) to other petrol
Poor	25	1.096 (0.009)	18.7 (14.8)
Medium	302	1.098 (0.007)	14.8 (12.6)
Good	157	1.100 (0.012)	8.7 (10.7)
Very good	118	1.100 (0.009)	10.8 (10.5)
Unsurveyed	2	1.089 (0.04)	4.8 (1.0)

Source: Own elaboration.
Note: Standard deviation in parenthesis.

As for the relationship according to the type of road, we initially commented the economic, social and geographical characteristics of Galicia determine the type of retailer. 63% of stations are situated in rural roads, although the highest average price for these products is in the city where 28 % of all petrol stations are; motorways make up 1.6% of

the total. As might be expected petrol stations are further apart in rural roads and motorways than in urban centres, business and work centres and even industrial areas (Table 3).

TABLE 3: DESCRIPTIVE STATISTICS (BY TYPE OF ROAD)

Type of road	Retailers	Price	Average Minimun time (mins) to other petrol
Rural	382	1.099 (0.009)	13.8 (11.5)
Industry / Office	34	1.099 (0.019)	4.3 (4.0)
Urban transient	173	1.100 (0.009)	11.3 (13.7)
Motorway	10	1.100 (0.001)	21.0 (15.1)
Others	5	1.090 (0.004)	4.6 (2.5)

Source: Own elaboration.
Note: Standard deviation in parenthesis.

The previous data seems to show us that accessibility has two contrary effects upon final prices. On the one hand, consumers have less accessibility, as do the competitors, and this means that retailers may increase their prices; on the other hand, points of sale with lower levels of accessibility are located in places with less demand, so there may be less disposition to pay and consequently the price equilibrium could be lower. In Section 4 we analyze in depth how these two aspects may influence the setting of the final price.

3. Empirical strategy

With these market characteristics, the issue is whether some type of determining factor derived from the accessibility affects the prices of the product analyzed. By improving accessibility do consumers increase their chances of getting better prices? To understand this we have focused on isochronic or cumulative opportunity measurements, which is a traditional approach developed by Wachs and Kumagai (1973) and Vickerman (1974). This indicator counts the number of potential opportunities that may be reached within a predetermined travel time period or distance. It is expressed as:

$$A_i = \sum_{j=1}^{J} B_j a_j \qquad (1)$$

Where A_i is accessibility measured from point *i* to potential activity in zone *j*, B_j is a binary value equal to 1 if zone *j* is within a predetermined threshold, and a_j are the opportunities in zone *j*.

Using this measure as a starting point, and adapting the consumer's decision to acquire petrol in one service station or another, we propose the following analysis. We have stipulated beforehand, for the group of petrol stations studied, how many of them have a competitor, regardless of brand, within twenty minutes travelling distance. We have obtained the probability of those stations having a lower price than the station of origin (Pr_i), it is as follows:

$$\mathrm{Pr}_i = \sum_{j=1}^{N} \frac{n_j}{N} / P_j < P_i \qquad (2)$$

P is the price of petrol 95 at the station of origin *i* or at the competitor *j*, N is the total number of petrol stations situated within 20 minutes of the subject, and n_j is the number of petrol stations in the zone whose prices are lower than station *i*.

We present, in the following Tables 4 and 5, the results by type of location and road traffic intensity (and in the Map II, Annex II). We have taken three variables into account: the average number of petrol station that make up this exogenous "radius" of attraction, the average discount that would be obtained from these competitors in Euros per litre, and the last column contains the probability according to the equation (2).

91% of petrol stations are located either in rural or urban areas. The first classification shows that the points of sale located on rural roads have a lower number of competitors in a given radius than the urban ones do, 7.8 as compared to 10.5, despite the average discount being greater in the rural environment. Nevertheless, the probability that the individual must consider is greater in the city than in the country, 0.24 versus 0.20. This indicates that, in a Galician city, consumers of petrol 95 have a higher probability of obtaining a lower price in another petrol station, if they continue the search; this is because there is a greater concentration of population and activity.

TABLE 4: PROBABILITY TO OBTAIN BETTER PRICES (POR TIPO DE CARRETERA)

Type of road	Average number of petrol stations within 20 minutes, with better prices	Average discount in petrol stations within 20 minutes	Pr_i
Rural	7.82	0.0030	0.204
Industry / Office	10.32	0.0013	0.176
Urban transient	10.49	0.0021	0.242
Motorway	12.2	0.0004	0.109
Others	3.66	0.0483	0.507

Source: Own elaboration.

Table 5 shows a similar result but uses road traffic intensity instead. Here the probability of finding a petrol station with a lower price compared to the previous grouping is 12% for those with average intensity, which is 50% of all the petrol stations; it is 7% for those with good intensity, and for those with very good intensity it is 6%. Consumers who use poor intensity road only had a 4% possibility of finding a lower price at other petrol stations located within twenty minutes.

TABLE 5: PROBABILITY TO OBTAIN BETTER PRICES (BY AVERAGE TRAFFIC INTENSITY)

Type of road	Average number of petrol stations within 20 minutes, with better prices	Average discount in petrol stations within 20 minutes	Pr_i
Poor	11.64	0.0026	0.042
Medium	8.68	0.0024	0.122
Good	8.41	0.0035	0.072
Very good	9.09	0.0020	0.060
Unsurveyed	2	0.0022	0.166

Source: Own elaboration.

Despite the aforementioned, a consumer who knows the petrol station prices in this radius[9] doesn't have to travel to that service station. In order to more clearly define the decision to change, we use the traditional sequential search models developed by Stigler in

[9] It should be borne in mind that service stations in Spain are obliged to display their prices on panels at their entrances; they must also make their prices available to the Ministry of Industry, Trade and Tourism, who then publishes them weekly in its webpage.

1961. In our case any consumer near or at a station would have to choose between filling up there, or evaluate the "benefit" of moving to another petrol station to seek a lower price, while taking the distance and time involved into account. For this last point, we have updated and used and time value data from the European HEATCO project, for business passengers using cars by the hour. In Spain 2002, it was equal to €25.95, which would be €30.05 in 2007 if we update the figure using the RPI.

So a consumer would seek a product until the expected discount was lower than or equal to the search costs. In this case the proposed equilibrium equation would be:

$$\left[P_i - P_j \,/\, P_i > P_j \right] \mathrm{Pr}_i = \mathrm{VT}^*\mathrm{Distance} \qquad (3)$$

VT is the value of time and Distance is the number of minutes between petrol station *i* and the lower priced *j*, the lower price being a necessary condition. From (3), assuming forty litres for each fill up and using the Galician database, the results indicate that no rational consumer using this type of analysis would travel from the nearest petrol station to another in search of this discount, motivated by a value of time that is greater than the potential benefits. If we considered the value of time for leisure trips, which is €9.60 when updated to 2007, in only three of the 511 petrol stations would a consumer be interested in travelling to another.

To sum up all this indicates that price differences exist, and that the probability of getting cheaper prices is greater when the ease of access to the points of sale is better. Access improves in line with a greater number of points of sale, higher urban concentration and more intense traffic. Despite this, the time costs would mean that no rational consumer would travel to another different petrol station to find an expected discount that doesn't compensate the costs incurred. Authors such as Borenstein (1991) have already indicated that these scarce benefits in searching for a cheaper petrol station are one possible reason for fixing prices above the perfect competition level. We now pass on to Section 4, with the objective of econometrically establishing the relationships among prices, type of road, population, brands and in general the accessibility.

4. Econometrical analysis

In this section the alternative methodology we use follows on from the paper by Borrell and Perdiguero (2007), and we have borne in mind the information it provides on service

station location. This methodology deals with the price applied by stations, in the context of the distance to the other surrounding petrol stations.

There is a long history of competition analysis in industrial economics, especially when companies are located in different points of the territory. The first theoretical references were by Hotelling (1929) and Salop (1979), who respectively developed the linear city model and the unitary circular spatial market theories. These models have already demonstrated the importance that the proximity of the competitors can have on the prices applied by the different points of sale. Competition in terms of space is by its very nature a paradigm of product differentiation. Each operator first chooses the physical location and given the competitors' location it then sets the price to offer its products at.

In recent years a whole set of methodologies has been developed to deal with product differentiation model data. The foundation for the empirical development of these models was laid by Berry (1994), Pakes, Berry and Levinshon (1993) and Berry, Levinshon and Pakes (1995); however, more recently Ivaldi and Verboven (2005) have shown its growing usefulness in analyzing the competition policy cases.

The equilibrium equations for the aforementioned models show how the prices at different points of sale depend on the elasticity and cross elasticity of other points of sale. One direct way of estimating these elasticities is to calculate the demand equations, while bearing the product differentiation in mind. However, such a direct estimate would require detailed information, which is seldom available, on aspects like the characteristics that differentiate the products and quantities sold by each petrol station.

We will calculate the effect of the demand and cross elasticities using the effect of the analyzed service station and of rival brands upon the very price it fixes. Having relatively close rivals should lower the price, as the demand elasticity will be higher. In other words this is the quantity the seller would cease to sell, if the price increase is greater than its nearby rivals, although this depends on whether those rivals sell the same brand. Our empirical estimate is the following:

$$P_i = \alpha_0 + \alpha_1 \text{ N rivales } (\mu \text{ minutes})_i + \alpha_2 \text{ N propias } (\mu \text{ minutes})_i + \varepsilon_i \qquad (4)$$

i is each one of the 511 service stations and μ varies between 1 to 30 minutes, which is a greater range than the previous 20 minute analysis. We carry out 30 econometric

estimations beginning with one minute of travel time, where we relate the price of the service station *i* to the number of rivals and the number of same brand petrol stations within one minute and so on.

We break down the data, in order to analyze the more detailed market structure. Table 6 shows the number of same brand and rival petrol stations within the 1 to 30 minute time interval for each service station. The information in this table should affect the econometric analysis, as we would expect the competitive effect of rival petrol stations to negatively influence prices; conversely, same brand stations could positively affect them, this is the domino effect within the market. This latter relationship should be higher, whenever this station is less accessible or more isolated from other stations.

TABLE 6: MARKET STRUCTURE IN INFLUENCE ZONES BY TRIP TIME (MINUTES)

Minutes	Number of petrol stations compiting	Number of petrol stations in monopoly	Average number of competitors in competition markets	Average Lumber of own petrol stations
1	15	589	1	0.14
2	54	550	1.26	0.17
3	111	493	1.54	0.25
4	141	463	1.88	0.32
5	186	418	2.17	0.41
6	215	389	2.51	0.50
7	240	364	2.76	0.59
8	274	330	3.01	0.73
9	306	298	3.21	0.84
10	335	269	3.45	1
11	351	253	3.76	1.14
12	370	234	4.07	1.30
13	386	218	4.43	1.40
14	406	198	4.78	1.54
15	427	177	5.04	1.65
16	442	162	5.40	1.79
17	455	149	5.66	1.92
18	470	134	5.97	2.06
19	477	127	6.36	2.23
20	487	117	6.67	2.38
21	496	108	6.99	2.48

22	508	96	7.23	2.65
23	514	90	7.61	2.79
24	520	84	7.97	2.98
25	524	80	8.28	3.17
26	530	74	8.58	3.33
27	533	71	9.00	3.50
28	536	68	9.41	3.63
29	549	55	9.69	3.79
30	551	53	10.17	3.95

Source: Own elaboration.

Prices set by the stations may depend on the number of rivals and the number of same branded service stations, and these two variables may in turn depend on the market price. A high price equilibrium is a sign for other firms to enter the market. The variables for the numbers of rival and same brand petrol stations could create problems of endogeneity. To resolve this problem we have carried out a two stage least squares analysis, using population, dummy variables of rival brands, type of location, and traffic intensity for the road where petrol station is located. This way we also include the effects of ease of access on the price at each petrol station. Every road has had its fixed effects included, in order to control any common effect it may have on its petrol stations.

In the following Table 7 we can see the econometric results.

TABLE 7: ECONOMETRICAL RESULTS EQ. (4). INSTRUMENTAL VARIABLES ANALYSIS

	1 minute	**2 minutes**	**3 minutes**	**4 minutes**	**5 minutes**	**6 minutes**	**7 minutes**	**8 minutes**
Constant	1.0990***	1.0990***	1.0988***	1.0989***	1.0992***	1.0993***	1.0994***	1.0995***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nrivales(.)	-0.0045	-0.0023	-0.0012	-0.0014*	-0.0015**	-0.0012**	-0.0009*	-0.0007*
	(0.495)	(0.376)	(0.263)	(0.080)	(0.044)	(0.049)	(0.073)	(0.079)
Npropias(.)$_i$	0.0002	0.0035	0.0037	0.0032	0.0029*	0.0024*	0.0016	0.0011
	(0.249)	(0.258)	(0.119)	(0.119)	(0.074)	(0.075)	(0.113)	(0.132)
Sargan Test	19.289	19.003	17.552	17.296	16.341	16.313	17.120	17.399
	(0.201)	(0.214)	(0.287)	(0.301)	(0.360)	(0.362)	(0.312)	(0.296)
	9 minutes	**10 minutes**	**11 minutes**	**12 minutes**	**13 minutes**	**14 minutes**	**15 minutes**	**16 minutes**
Constant	1.0995***	1.0996***	1.0997***	1.0997***	1.0998***	1.0998***	1.0999***	1.0999***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nrivales(.)	-0.0006*	-0.0006*	-0.0005*	-0.0005*	-0.0004*	-0.0004	-0.0004*	-0.0004*
	(0.067)	(0.077)	(0.096)	(0.086)	(0.069)	(0.102)	(0.081)	(0.060)
Npropias(.)$_i$	0.0011	0.0009	0.0007	0.0007	0.0006	0.0005	0.0005	0.0005
	(0.105)	(0.129)	(0.165)	(0.145)	(0.123)	(0.175)	(0.146)	(0.112)

Sargan Test	16.987 (0.320)	17.528 (0.288)	18.036 (0.261)	17.760 (0.276)	17.387 (0.296)	18.189 (0.253)	17.604 (0.284)	17.039 (0.317)
	17 minutes	**18 minutes**	**19 minutes**	**20 minutes**	**21 minutes**	**22 minutes**	**23 minutes**	**24 minutes**
Constant	1.1000*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)
Nrivales(.)	-0.0004 (0.055)	-0.0004** (0.039)	-0.0003** (0.037)	-0.0003** (0.039)	-0.0003** (0.034)	-0.0003** (0.032)	-0.0003** (0.028)	-0.0003** (0.029)
Npropias(.)$_i$	0.0005 (0.102)	0.0005* (0.077)	0.0004* (0.079)	0.0004* (0.084)	0.0004* (0.075)	0.0004* (0.072)	0.0004* (0.068)	0.0004* (0.071)
Sargan Test	16.930 (0.323)	16.342 (0.360)	16.254 (0.365)	16.269 (0.364)	15.900 (0.389)	15.857 (0.392)	15.657 (0.405)	15.767 (0.398)
	25 minutes	**26 minutes**	**27 minutes**	**28 minutes**	**29 minutes**	**30 minutes**		
Constant	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)	1.1001*** (0.000)		
Nrivales(.)	-0.0003** (0.029)	-0.0003** (0.030)	-0.0003** (0.024)	-0.0003** (0.024)	-0.0003** (0.026)	-0.0003** (0.025)		
Npropias(.)$_i$	0.0004* (0.070)	0.0004* (0.072)	0.0004* (0.060)	0.0004* (0.062)	0.0004* (0.066)	0.0004* (0.062)		
Sargan Test	15.840 (0.393)	15.868 (0.391)	15.386 (0.424)	15.388 (0.424)	15.513 (0.415)	15.400 (0.423)		

Standar error in brackets (* 10%, ** 5%, *** 1%).

As we can see in the previous table the signs for the variables are what we expected, although on occasions there are no significant results in the first few minutes. Also, we can see how the negative competitive effect of the rival decreases; i.e. the further away the rivals are then the less the competition is, and the effect on the price the petrol stations set is less. The variable for the effect caused by the same branded stations is equally reduced. This possible market domination effect is diluted, as we widen the market; the further away the same branded petrol stations are, then the possibility of setting higher prices is less. Finally, we must emphasise that all the Sargan Test estimates are exceeded. This suggests that both the instruments used to resolve the previously mentioned endogeneity problems and the estimations are consistent.

After estimating the effect of the number of rivals and the same branded petrol stations on the prices that service stations set, we continue by studying what percentage of the distribution margin these effects cause (Table 8).

TABLE 8: PRICE INCREASE OF HIPOTETIC MONOPOLIST USING DAILY AVERAGE INTENSITY AS EXPLICATIVE FACTOR OF NUMBER OF PETROL STATIONS

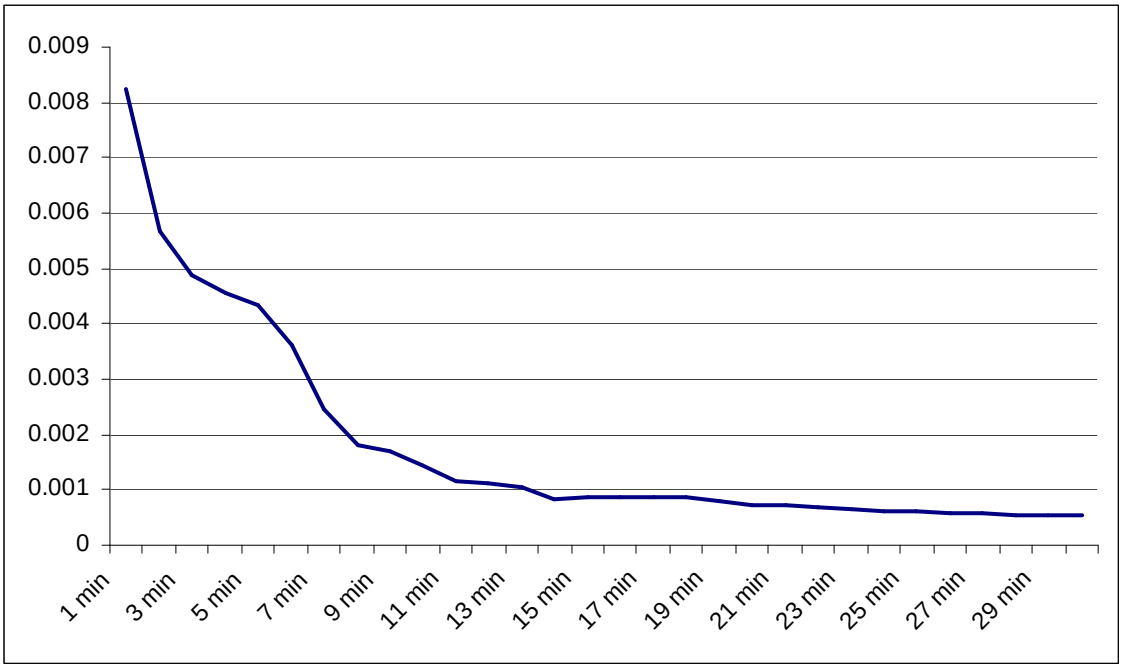
Minute	(1) Rival´s Price Effect on market (€)	(2) Own´s Price Effect on market (€)	(3) Sum of Effects	(4) Average wholesale margin of distribution (competitive markets)	(3)/(4) = (5) Price-Effect of shifting from competition to monopoly (competitive markets, %)
1 minute	0.0043603	0.0038955	0.0082558	0.0731393	11.29%
2 minutes	0.0022425	0.0034319	0.0056744	0.0712141	7.97%
3 minutes	0.0012317	0.0036488	0.0048805	0.0720256	6.78%
4 minutes	0.0013417	0.0032207	0.0045624	0.072391	6.30%
5 minutes	0.0014881	0.0028563	0.0043444	0.0724979	5.99%
6 minutes	0.0012486	0.0023784	0.003627	0.0724136	5.01%
7 minutes	0.0008544	0.0015995	0.0024539	0.0723024	3.39%
8 minutes	0.0006837	0.0011286	0.0018123	0.0721275	2.51%
9 minutes	0.0006387	0.0010619	0.0017006	0.0724508	2.35%
10 minutes	0.0005822	0.0008765	0.0014587	0.072653	2.01%
11 minutes	0.0004803	0.0006801	0.0011604	0.0726889	1.60%
12 minutes	0.0004692	0.0006494	0.0011186	0.0726897	1.54%
13 minutes	0.0004349	0.0006129	0.0010478	0.0726337	1.44%
14 minutes	0.0003587	0.0004815	0.0008402	0.0727266	1.16%
15 minutes	0.0003676	0.0004955	0.0008631	0.0727723	1.19%
16 minutes	0.0003712	0.0005034	0.0008746	0.0728179	1.20%
17 minutes	0.0003642	0.0004998	0.000864	0.0727869	1.19%
18 minutes	0.0003666	0.0004963	0.0008629	0.0727395	1.19%
19 minutes	0.000338	0.0004466	0.0007846	0.0727403	1.08%
20 minutes	0.0003161	0.000418	0.0007341	0.0728175	1.01%
21 minutes	0.0003119	0.0004203	0.0007322	0.0728519	1.01%
22 minutes	0.0002907	0.0003902	0.0006809	0.0729099	0.93%
23 minutes	0.0002839	0.0003815	0.0006654	0.0729203	0.91%
24 minutes	0.0002718	0.0003556	0.0006274	0.0729984	0.86%
25 minutes	0.0002633	0.0003449	0.0006082	0.0729887	0.83%
26 minutes	0.0002532	0.000326	0.0005792	0.0729995	0.79%
27 minutes	0.0002503	0.000326	0.0005763	0.0730501	0.79%
28 minutes	0.0002395	0.0003144	0.0005539	0.0730519	0.76%
29 minutes	0.000231	0.0003037	0.0005347	0.0730599	0.73%
30 minutes	0.000226	0.000303	0.000529	0.0730511	0.72%

Source: Own elaboration.

In Table 8 we can see the effect that the monopolization of the different markets has on the gross distribution margin. The distribution margin has been calculated as the final price less taxes and less the international wholesale price[10]. Taxes may include special taxes, retail taxes, state and regional taxes and VAT. The average margin for petrol stations with competitors in the different markets is found in Column 4.

The effect of monopolization is the sum of the effects of the rivals plus the effect of the own brand petrol stations. Column 1 is if we monopolize the market, we lose the competitive effect; whereas the effect of market domination is in Column 2. It is as if, to coordinate and dominate the market, a company buys up all its rivals, ceases to have competition, and then establishes even more petrol stations. Since both effects reduce as the market size increases, obviously the sum of the two also decreases; this total effect is found in Column 3. The following graphs show this, as well as the effect as a percentage of the margin.

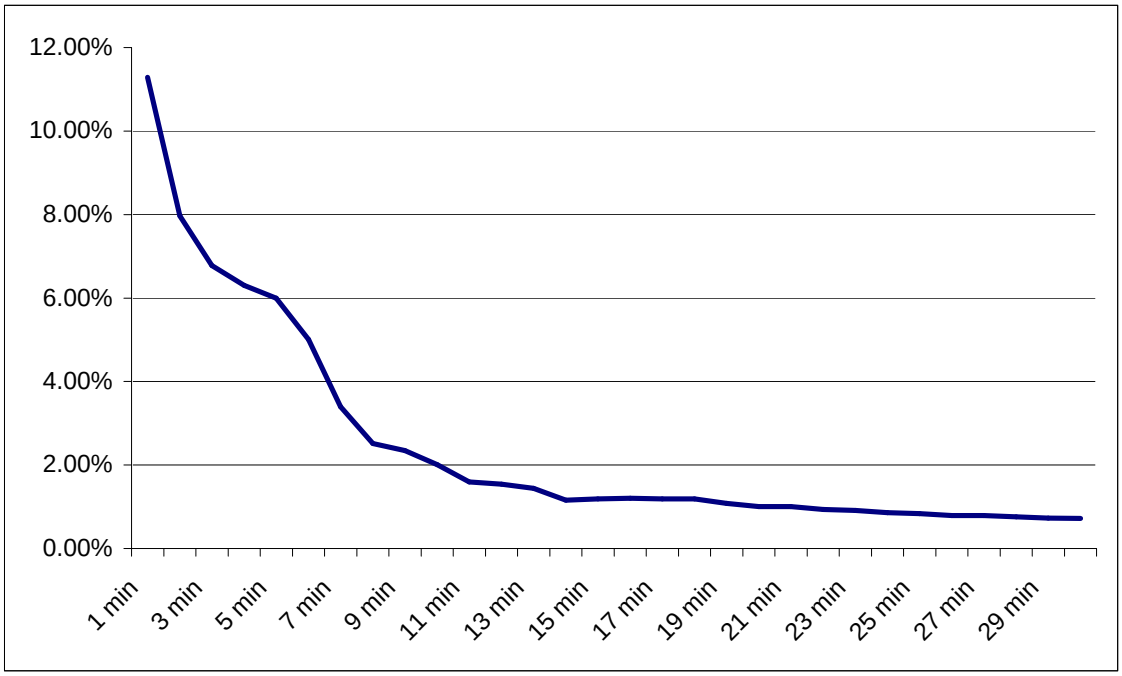
GRAPH 1. MONOPOLIZATION EFFECTS IN MARKETS



Source: Own elaboration.

[10] For a more detailed explanation of the components that make up the price of petrol, see Miras (2007).

GRAPH 2. MONOPOLIZATION EFFECT AS PERCENTAGE OVER WHOLESALE MARGIN



Source: Own elaboration.

As you can see in the final graph, this total effect on the distribution margin is between 11.29% and 0.72%. Upon being monopolized, that market would expect an average increase of at least 5%, in the margin when there is six minutes travel time. This margin is defined in the SSNIP Test (Small but Significant Non transitory Increase in Prices Test). It has been used to define where, how and why the petrol stations compete, and assumes a standard threshold used by defence of competition organisms.

If we define the market as six minutes travelling distance from each point of sale, then there are 215 petrol stations with rivals in the market and 389 petrol stations that have no rivals (See Map I in Annex II).

Of these 389 service stations that have no rivals in the market 277 of them have no same branded petrol stations nearby, and this could indicate that those markets may be natural monopolies. The demand in the existing market may not allow for the presence of more than one operator, and thus there is no possibility of competition. It should also be stated that there may be entry barriers that prevent new operators from entering those markets, thus provoking a monopoly situation. Barriers that may limit competition within those markets are the long time period needed for opening a service station, the cost of

land and municipal regulations that on occasions impede the opening of such businesses. Eliminating these barriers could encourage new agents to enter and lower the market equilibrium price.

The other 112 that don't have market competition still have one or more service stations in the same market. Market demand permits the existence of more than one point of sale, and if it isn't part of the same company the price equilibrium is lower. Liberalizing and facilitating brand changes at the points of sale would improve the presence of other companies within the markets. As in the previous case, the entrance of new operators would facilitate the existence of new brands in these monopolized markets, and would lower the market equilibrium price. Measures for eliminating the entry barriers could play a role in this equally important case.

5. Conclusions

This paper has concentrated on demonstrating the direct relationship between accessibility and the level of competition in a specific market. We have compiled a database for the hydrocarbon retail sector in the Spanish autonomous region of Galicia, which possesses both urban and rural areas. Among other factors this database contains price information, locations, brands, type of road and volume of traffic. Its fundamental objective is to determine what affects the probability of finding a cheaper petrol station within a certain time period, while controlling the characteristics of the road and the station's location.

By using descriptive and econometric methodology, and from the results for both roads, we can conclude that accessibility has two contrary effects upon final prices. First, less accessibility fosters market power, because with less demand the price equilibrium may be less. Second, consumers from rural areas, or areas with low traffic intensity, have less chance of reaching lower priced service stations within a twenty minute drive. Further conclusions are that third, if we include the value of time, no rational consumer would deviate from the nearest service station on route to acquire petrol at another with cheaper prices. Fourth, using the Agencies of Competition Policy´s methodology (the SSNIP test), service stations can establish a dominant position, if there are no others within in a six minute distance, even when the competitors sell the same brand.

Contrary to the results by de van Wee *et al* (2001), city centres aren't necessarily more attractive for companies. The reduced accessibility increases the probability of companies abusing their dominant position in the local geographical market. The key to pricing policy is not to be situated either in a periphery or a city centre, unless access to the rival points of sale is low. The benefits will, nevertheless, depend on the level of demand at the point of sale and the price levels it can set, and/or the accessibility to other rival petrol stations.

As a final recommendation for economic policy, we suggest that when planning the services that stations could offer, accessibility to establishments selling other brands should be borne in mind, as there is a significant effect on the price equilibrium and consequently on social welfare.

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Annex I

Definition of variables (from Catalist)

Primary Traffic.- This is an estimate of the 24 hour average two-way traffic flow on the primary street to the nearest thousand. Guidelines to the various definitions used are:

Poor: Traffic levels are less than 5,000 vehicles per day.

Medium: Traffic levels are between 5,000 and 15,000 vehicles per day.

Good: Traffic levels are between 15,000 and 25,000 vehicles per day.

Very good: Traffic levels are in excess of 25,000 vehicles per day.

Site Location

Rural: Countryside background or low density residential and industrial use. Also locations on long distance commuter routes which experience consistent traffic flows e.g. a site on a quiet stretch of trunk road.

Industry/office: Low residential back-up and much evidence of commercial units e.g. industrial/office/retail. Applicable to business infrastructures such as port areas, manufacturing, distribution centres, shopping centres etc.

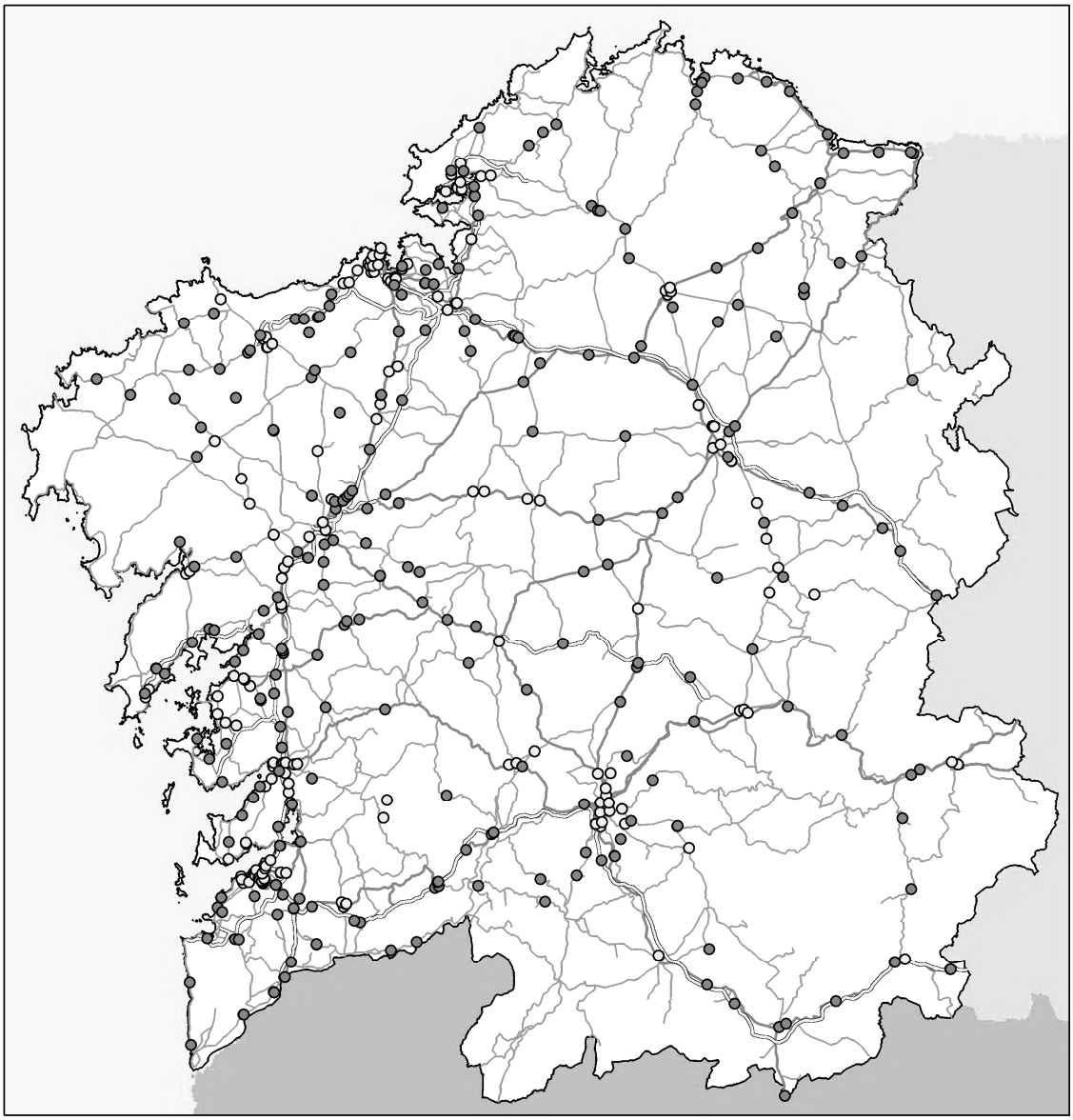
Residential: Tend to be located away from the commercial and industrial areas and surrounded by much private housing.

Urban Transient: Characterised by high traffic volumes spread evenly throughout the day. Bypasses and ring roads are included in this class.

Motorway

Annex II

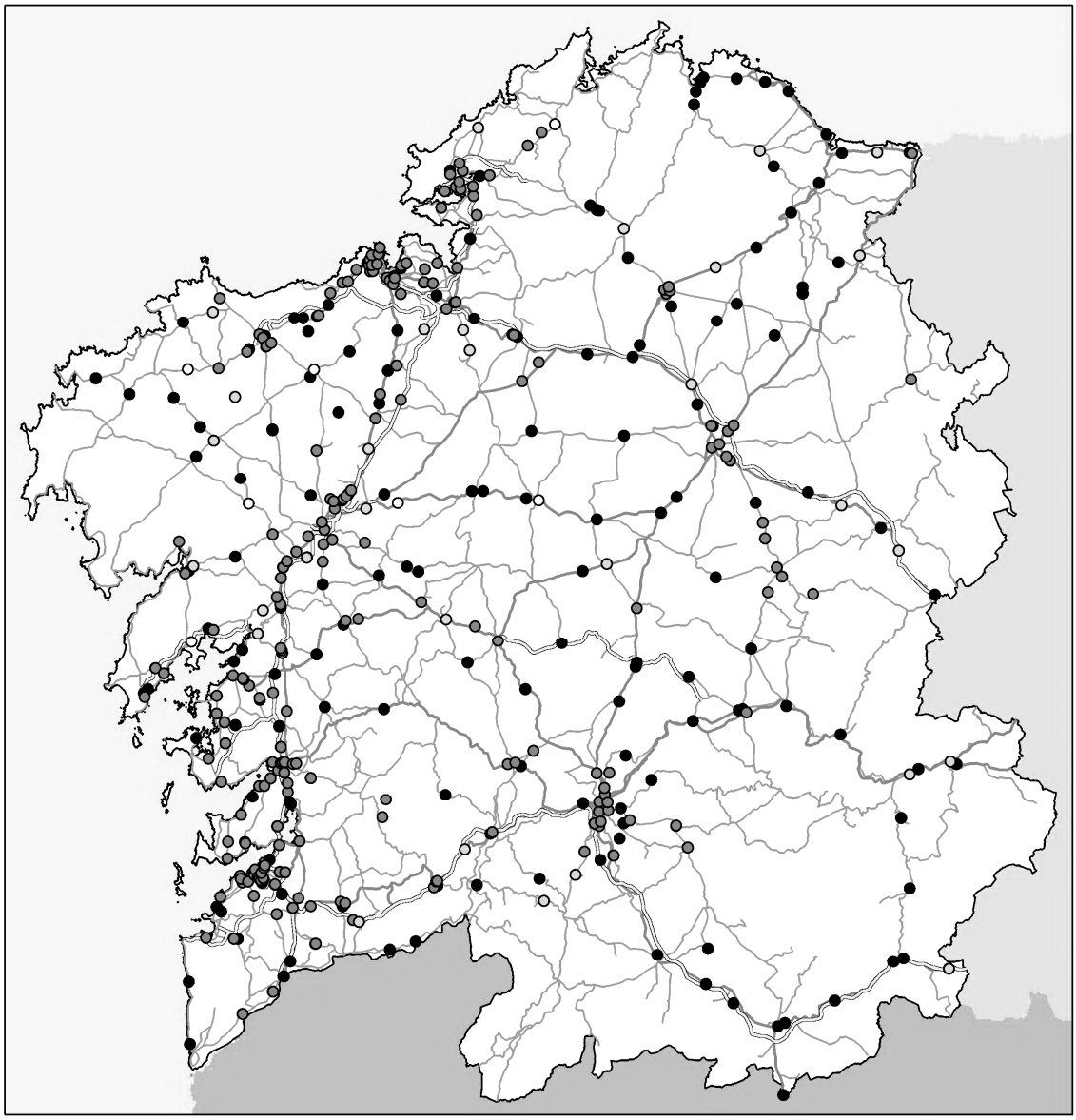
Map I: Distribution of petrol stations within Galicia



Note: White points are petrol stations with competitors in less than 6 minutes**.** The **Grey ones** are petrol stations without competitors in less than 6 minutes.

Annex II

Map II: Probabilities to obtain petrol stations with less price



Note: White points are petrol stations with high probability (more than 0,5)**. Low Grey** are those petrol stations with medium probability. **Medium Grey** are those with low probability. The **Black ones** are petrol stations with probability equal to zero.