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Regional Finance and Competition Policy:

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Summary

Market competition levels affect all agents of an economy: businesses, consumers and the State. Traditional analysis has evaluated the State's effects on the other agents, but no analysis has been conducted regarding the inverse relationship. Thus, the aim of this study is to estimate the tributary income losses that low levels of competition in the retail petrol market could cause in it, using for this aim the data from Canary Islands Autonomous Community. Firstly, we will use Parker and Röller´s methodology (1997) to measure the level of competition and confirm a deficiency. Then, using estimated rates, we will determine the differences that would appear in tributary income if the market were to behave as a *Cournot*´s model. Our results show that the lack of competition causes a substantial loss of tributary income for this region, somewhere between 5 and 10 percent of the real income from the tax on unleaded petrol for the year 2004.

Key Words: Regional Finance, Oligopolistic Competition, Gasoline Market, Conduct Parameter.

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1. Introduction

The existence of market competition directly affects not only the consumers and the operating companies, but also a third economic agent: the State. This fact indirectly affects public income as well since the greater the competition level, the greater the quantity exchanged, according to the different market structures. The result is greater economic activity, and thus, more income from direct taxes, indirect taxes, etc.

This phenomenon is especially relevant within the hydrocarbon market. The multiple uses and high consumption of petrol products emphasise the importance of this sector in any economy, both publicly and privately. Over the last two decades, the petrol tax has increased, signifying a large amount of income for the State (and Autonomous Communities in Spain).

All areas of this sector in Spain have undergone considerable change during the last two decades[3], having progressed from a public monopoly to complete liberalisation, excluding the pipeline transport network, which is still somewhat regulated. This restructuring can be divided into three stages (Comisión Nacional de la Energía, 2003). The first stage lasted until 1984 and featured a high level of state market intervention and thus, a public petrol monopoly. The liberalisation process began in the second stage, which occurred between 1984 and 1992. The objectives during this time were to abolish the public monopoly, moving from the regulation of administrative prices to a regulation of maximum prices, and to partially privatise Repsol, the public company operating in this sector. Finally, 1992 marked the beginning of the third stage, when the liberalisation process intensified. The most significant progress included the deregulation of maximum

[3] For a discussion of this process see Bel (2002).

prices, introducing a free market pricing system; the elimination of a minimum distance between petrol stations; and complete privatisation of Repsol. As a result, the Spanish petrol market is one of the most liberalised markets, and one which experienced a relatively shorter deregulation period.

Despite this transition, Spanish market structure has not changed significantly. It still has a high concentration of wholesale production (in 2002, Repsol's refinement capacity comprised 61 percent of Spain's total capacity), with a similar situation in the retail sector, despite an increase in points of sale derived from the removal of certain opening requirements[4] (in 2002, the 3-firm concentration ratio (CR_3), with regards to the number of retail points of sale, was 72 percent, according to the Enciclopedia del petróleo, petroquímica y gas, 2002).

Market concentration can result in less competition among companies, especially when the end consumer is located in a geographically limited area, as is the case with the Canary Islands. According to Gal (2003), there are three possible effects on competition and companies in smaller markets: natural monopoly behaviours, dominant firms and oligopolistic conduct. The first does in effect take place in this market, whereas the other two, which are interrelated, shall be analysed in the first objective of this study.

However, this sector's structure is not the only element that has undergone significant change over the last two years. Tax policies related to hydrocarbon consumption have also changed substantially. A series of tax reforms has sparked a gradual increase in petrol taxation on the Spanish mainland (although Spain still has the lowest petrol taxes in Europe) as well as the introduction of a special tax for the Canary Islands Community. As we will see in section 3, this tax is an

[4] In this sense, the only obligations were the obligations of service and of notifying the Comisión Nacional de la Energía (CNE) of the free market pricing.

important source of income for the Canary Islands financing system, making the analysis of the potential impact that competition may have on this tax all the more significant.

Considering this situation, this study will be conducted as follows. We begin with two reviews: one on the main theoretical and empirical studies that show a link between fiscal policies and the petrol market; and one on the most important contributions in the competition analysis of this sector (section 2). We then reveal the main characteristics of the Canary Islands' hydrocarbon market from two different perspectives: tax and petrol market data (section 3). In section 4, we present the empirical model used to confirm competition in the retail petrol market, allowing us to estimate the level of competition in section 5. In section 6, we show what effects this behaviour may have on the region's tributary income and section 7 summarises the conclusions of this report.

2. Literature and theoretical framework

Studies that link tributary income with the petrol market revolve around two issues: on the one hand, the effects that changes in petrol taxation have on collection, prices and social welfare; and on the other, the ability of petrol taxes to internalise the negative external consequences of its consumption (mainly pollution).

A good example of the first approach is the study by Uri and Boyd (1998). By implementing a model of general equilibrium consisting of 14 production sectors and 14 consumer sectors, they evaluate how a change in petrol and gas oil taxation would affect the United States' economy. One of the limitations of these calculations is that they assumed elasticity-price of the demand is zero. The study concludes that a tax decrease would bring about a higher output level, an increase in goods and services consumption, as well as a boost in welfare. On the other hand, government income would decreases. Although this scenario represents a 66 percent increase of welfare, it is worth mentioning that the study does not assess other possible effects, such as the short- and long-term environmental consequences that this tax reduction may entail.

As regards Spain, Labandeira and López (2002) find little effect on wealth distribution despite possible tax reforms, mainly due to the firm nature of the demand. Romero and Sanz (2003) also analyse the results of a new petrol tax in the Spanish market. The authors find the new tax causes a slight decrease in social welfare.

In turn, Besley and Rosen (1998), analyse the possible interrelation between state and federal taxes. By using an estimate through least ordinary squares and focusing on the petrol and cigarettes taxes, the authors conclude that when the federal government increases taxes, states respond by raising theirs in turn. Likewise, the authors find empirical evidence that states with larger petrol and cigarettes output have fewer taxes on these goods, which they feel is indicative of political pressure from business lobbies.

At a local level, Hawkins and Wallace (2006) analyze what are the effects of changes in the demographics for a taxing jurisdiction. Using household data and focusing on some commodities (including motor fuel), they argue that "(…) An exemption for food at home provides relatively less relief for working households and relatively more for retired and transfer-pay-reliant households while a decrease in the rate on motor fuel is more beneficial for the same working constituents". For this reason, they conclude that commodity tax policies have to establish relative group priorities when evaluating tax changes.

Along the same lines, Chouinard and Perloff (2004) use a data panel to determine how much final retail and wholesale prices vary with regard to the percentage variation of federal and/or state tax in the United States. This study's weakness is that it assumes the wholesale petrol market operates in perfect competition. One noteworthy conclusion is that the state tax is higher in states with relatively less petrol consumption, as found in the previous study.

The second part of the analysis of the relationship between the petrol market and tributary income concerns the use of petrol taxes to correct polluting effects. West and Williams III (2004) focus on the regressive nature of the environmental petrol tax. The authors consider progressive/regressive nature of taxing petrol when the share of taxes rises/decreases with income. Using consumption data and the methodology described by Deaton and Muellbauer (1980), these authors find that: first, the less elastic the demand, the higher the tax regression; and second, the use of petrol tax increases to finance a decrease in labour taxes makes the policy less regressive, despite the fact that using fiscal income to finance fixed taxes actually makes it progressive.

As regards the Spanish market, Asensio, Matas and Raymond (2003) establish the progressive nature of taxing petrol, although from a certain income level, this tax becomes regressive again.

In summary, all studies that link the petrol market with tributary income primarily focus on the general regressive nature of the tax on its consumers (although it depends on income level and elasticity of demand), as well as on its efficiency as an internalising mechanism of external environmental effects generated by hydrocarbon consumption.

Nevertheless, our study introduces a number of novel ways of approaching the issue. First, in these aspects, the causal relationship of our analysis is the opposite of the one used in traditional literature. We do not look at the effect the tax may have on company and consumer behaviour. Rather we measure the effect of companies´ behaviour on public income.

Second, our study analyses the previously-unstudied Canary Islands market, therefore giving us two advantages when measuring its market competition: a less restrictive assumption when defining the relevant geographic market, and the simultaneous existence of both monopoly and oligopoly markets. Thus, we are able to compare our method's correct specification in order to measure the degree of competition.

In order to conduct our study, we must determine whether the companies' behaviour is competitive. A recurring study within Industrial Economy has focused on the existence of competition, or lack thereof, in different markets. Precisely within the petrol market, Slade (1986) rejects the hypothesis of fixed-price competition for the Vancouver retail market. The same author (1987 and 1992) also concludes that petrol prices for Vancouver behave according to a tacit collusion dynamic. This balance is altered by periods of price wars brought about by shocks in demand. Borenstein (1991), Shepard (1991), and Borenstein and Shepard (1996), obtain very similar results for the North American market.

In reference to Spain, the first results along this line of analysis are those described by Perdiguero (2006). He analyses the possible strategic performance in price fixing by companies via a dynamic model. The result shows empirical evidence of collusive prices in the petrol market.

In this article, we will estimate the level of competition in the Canary Islands petrol market through the methodology proposed by Parker and Röller (1997). Section 4 will discuss the findings further.

3. The Canary Islands petrol market

There are two main differences between the petrol markets of the Canary Islands and of Spanish mainland: the market structure and the tax system.

As opposed to the Spanish mainland, the Canary Islands market was not a public monopoly that was later privatised. In fact, the company CEPSA owned the first Spanish refinery funded by private capital, which was set up on Tenerife Island in 1930. It wasn't until twenty years later that a second refinery was created on national territory. Thus, private companies sprung up that, although they could not refine petrol themselves, they could still serve the market with supplies from the aforementioned refinery.

Taking into account the performance of hydrocarbon prices in the public sector, this behaviour has been (and still is) absolutely inferior to that registered in Spanish mainland's service stations. This is due to the implementation of a tax on "fuels derived from petrol", which is only in effect in the Canary Islands. This is a single-phase tax applied to wholesale transactions, which is restricted by the regulation not to be above 75 percent of those applied on the Spanish mainland and in the Balearic Islands.[5] Table 1 summarises the type of duty applied until now, depending on the product.

INSERT TABLE 1

[5] The relevant regulations are Royal Decree (RD) 155/1995; RD 6/2000 and RD 114/2001. All these decrees set up the basic framework for service stations in the Canary Islands, in particular the minimum distance and opening requirements. Nevertheless, questions related to urban planning and municipal norms influence the barriers to the opening of new petrol stations more than the aforementioned legislation.

Graph 1 represents the total income from the Canary Islands Economic and Fiscal Regime (R.E.F.) for 2004. We can see that 18.2 percent is obtained from petrol fuel taxes, the second most important. This reveals the significance of this tax for the Canary Island treasury. This trend continues, although the figure has become less representative in the last five years. It acts primarily in favour of the General Indirect Canary Tax (I.G.I.C.), which in 2004 constituted 69.1 percent of the R.E.F´s total income.

INSERT GRAPH 1

As in Spanish mainland, the Canary Islands market structure is highly concentrated in industrial processes. An analysis of the existing service stations at the end of 2004 shows that DISA has 35.6 percent of market share, followed by Shell with 17.9 percent, and Texaco, with 14.3 percent of the Archipelago's service stations. It is worth noting that DISA has a monopoly in the islands of La Gomera and El Hierro, a fact that shall be used to contrast the competition model proposed in section 4 and to obtain two functions of petrol demand, depending on whether they are islands with a monopoly (La Gomera and El Hierro) or islands with more than one operator (the rest of the islands).

Considering this information, it seems the Canary Islands petrol market structure offers conditions conducive to low competition behaviour. This study aims to measure competition via the conjectural variation methodology, which, if we achieve a non-competitive result, will estimate the amount that the Canary Islands Treasury did not obtain in 2004. This calculation will be carried out with our model's estimated rates.

We will concentrate on the data used for the empirical application. This information dates between September 2003 and December 2004 (inclusive). All data is organised by month (except population) and island. The varying quantity is the volume of unleaded petrol expressed in cubic metres sold by retail distributors on each island, each month. Both the prices and the quantities sold have been provided by the General Direction of Industry and Energy of the Canary Island Government (We are grateful for their assistance).

Petrol's spot price is that of refined 95-octane petrol in the Rotterdam market. This information is obtained from O.P.E.C. The figures regarding population and number of air travel passengers have been taken from the Canary Statistics Institute (ISTAC) and Spanish Airport and Air Navigation (AENA) respectively. Transport and storage costs used have been calculated from the Comisión Nacional de la Energía's (CNE) website.

4. Tacit collusion: an empirical application

One of the initial aims of this study is to econometrically calculate a model that will gather together the behaviour of Canary Islands petrol market companies. However, the specific market characteristics affect the creation of this model. First, the analysis will be carried out as an average of each Archipelago island, without trying to determine results of a *Hottelling* localisation problem; second, and derived from the previous point, companies compete in a relevant geographic market (the island market) to increase their market quota; third, the product is considered homogenous.

Parker and Röller´s (1997) proposal was used to develop the conjectural variations methodology, for measuring tacit collusion, or its absence, in the Canary Islands hydrocarbon retail market. More recently, Jiménez and Perdiguero (2006a and 2006b), who developed the model in more detail, applied it in this very same market.

Starting with the operating benefits to be maximised by the company, we obtain the following condition of equilibrium

$$\theta \frac{\partial p_{ts}(.)}{\partial Q_{ts}} Q_{ts} + p_{ts}(.) - CM_{ts}(.) = 0, \quad \forall i \tag{1}$$

where $\theta = \lambda / N$ measures the company performance parameter. This parameter is falls between 0 and 1, and its meaning is as follows: $\theta = 0$, behaviour of perfect competition; $\theta = \frac{1}{N}$, *Cournot*-style competition; $\theta = 1$, perfect collusion performance.

For its empirical application, we conduct the analysis in two cases with different structures: the La Gomera and El Hierro islands, where DISA has a monopoly; and the rest of the islands, where the competition is intra-island and carried out amongst the companies in the market. The existence of this single proponent on both islands allows this data to be used in a model specification comparison. We must note a lack of broader information, which forces us to estimate an average behaviour parameter on the islands with an oligopoly, instead of one per island.

In order to empirically implement the theoretical model described previously, we will use the following linear demand function[6]:

$$Q_{ts} = \alpha_0 + \alpha_1 p_{ts} + \alpha_2 \left(POP_{ts} + TOURISTS_{ts} \right) + \alpha_3 TIME_t + \sum_{h=1}^{11} \alpha_h MONTH_h + \sum_{s=1}^{S} \alpha_S ISLAND_S + \varepsilon_{ts} \tag{2}$$

where Q_{ts} is the quantity sold by companies on island *s* at moment *t*, which depends on the price (p_{ts}), on the variable $(POP_{ts} + TOURISTS_{ts})$, which

[6] Due to the low temporal variability of welfare data (i.e. GDP or GDP per capita are annual data, while we are using monthly information for 3 years) these variables are not included in demand analysis. Nevertheless, we consider that population and fixed effects of Island and month may explain the influence of those variables not included in the model.

measures the number of inhabitants, plus the number of passengers that arrive by plane each month, and the variable $TIME_t$ which shows the existence of a certain petrol consumption trend, increasing or decreasing. Likewise, we will introduce dummy variables per island and per month, which will help explain the special traits and seasonal norms in each island's consumption.[7]

If we place the previously-mentioned demand function (2) in the equilibrium equation model (1), we can simplify the latter, which would be:

$$\frac{\theta}{\alpha_1}Q_{ts} + p_{ts}(.) - MC_{ts}(.) + \varepsilon_{ts} = 0, \tag{3}$$

Marginal costs are represented by $MC_{ts}(.)$ explained by the following equation:

$$MC_{ts} = \beta_0 + \beta_1\left(GASOLINESPOT_t + TRANSPORT_{ts}\right) + \sum_{h=1}^{11}\beta_h MONTH_h + \sum_{s=1}^{S}\beta_s ISLAND_s + \varepsilon_{ts} \tag{4}$$

where the marginal cost for companies on the island s at moment $t\left(MC_{ts}\right)$, depends on the price of refined 95-octane petrol in the Rotterdam market during that month plus the cost of transport and storage $\left(GASOLINESPOT_t + TRANSPORT_{ts}\right)$. One of the dummy variables per island and month must also be included, which summarises the main temporal peculiarities per island with regards to marginal costs. This marginal cost estimate is quite close to reality, according to the Consejería de Industria, Comercio y Nuevas Tecnologías (2004) report, which establishes that, "(...) the price system is based on a positive differential over international prices of European products (...) plus a transport differential, which is applied by CEPSA".

[7] The basic regulation is Law 5/1986. However, the Third Additional Provision of Law 8/1992 detailed the rule of not surpassing 75 percent of the Spanish mainland prices, including the transitory charge established in article 4 of this Law.

The solution to the problem involves a total estimate of the demand equation and the balance equation. To achieve this, we use a system of simultaneous equations through non-linear three least squares.

5. Results

The estimate of the specified model has been carried out in two phases. In the first, we calculate the performance of El Hierro and La Gomera, where DISA has a monopoly. In this case, as we can see in Table 2, the conduct parameter for the islands with a monopoly confirms this fact ($\theta = 0.99$). In this case, the coefficient that accompanies the price is -3.87; with a significance of 6 percent.

INSERT TABLE 2

Once the monopolised market have been analysed, we must do the same with the remaining five islands to determine the type of competition of each. Table 3 depicts the results obtained from the islands with an oligopoly. The rate accompanying the quantity is less than in the case of the monopoly. Its significance is 1 percent.

INSERT TABLE 3

On these islands, the conduct parameter is an average of 0.81. The econometric results obtained do not allow us to reject the possibility that this parameter may be a *Cournot*-style outcome $(\theta = 0.16)$, as is the case of a perfect collusion $(\theta = 1)$, although it is closer to a collusive balance than a *Cournot* equilibrium. For both estimates, the chi-squared test guarantees the overall model identification.

As far as the variable consisting of the population plus the number of passengers per airplane, we must conclude it is not significant in any case. The fact that the population varies little over the period analysed (this data is annual), coupled with the seasonal nature of tourism, causes the possible effect of this variable on prices to be grouped with the place and time "dummies" which we included in the model specification and estimate. However, the variable of the price of refined petrol in the Rotterdam market, plus the transport cost shows in all cases the sign that we expected, and its significance is 1 percent.

A priori, companies in each market (island) may behave differently. To prove this, we have carried out the preceding estimates from the differentiated model on the two islands with the highest petrol consumption (Gran Canaria and Tenerife) and the other oligopoly islands (Lanzarote, Fuerteventura and La Palma). Tables 4 and 5 depict these results. The conduct parameter does not vary much between these two island groups, nor amongst the group of oligopoly islands (compare with Table 3), although a lack of data provides less precise results.

In summary, our data shows that the company behaviour on islands with more than one petrol company seems to be more collusive than the *Cournot*-style competition outcome. However we cannot flat out declare the existence of a perfect collusion performance.

Despite being different markets, time periods and geographic areas, the results are similar to those obtained by Parker and Röller (1997) and Duso (2005) for the mobile telephone market, as well as to Fageda's (2006) evaluation for the Spanish air market. The same methodology was used in all these studies. The parallelism of these results may be explained by the fact that all of these cases involve concentrated network industries.

6. Fiscal effects of the level of competition

Having analysed the degree of competition and determined a degree of collusion greater than in a *Cournot* equilibrium, we shall assess whether this lack of competition in the oligopoly islands affects the Autonomous Community's income.

To achieve this, the first step is to calculate the average demand elasticity both in the monopoly and oligopoly markets. In our case, the demand price elasticity will be determined by the following formula:

$$\varepsilon = \frac{\partial Q_{ts}}{\partial p_{ts}} \frac{p_m}{Q_m}$$

where $\frac{\partial Q_{ts}}{\partial p_{ts}}$ is obtained from equation (2), and its value is the estimated coefficient α_1; Q_m and p_m, are the average quantities and prices, respectively. With this formula, the results obtained are -0.76 for monopolies and -1.7 for the oligopoly islands. Supposing a linear demand, economic theory has proven that, if companies operate as a monopoly, demand elasticity should be equal to (if $MC = 0$) or greater than $|1|$. In our case, the estimated elasticity is coherent with economic theory. The elasticity is somewhat greater than those obtained by other studies that exclusively analyse petrol demand, as seen in Table 6.

INSERT TABLE 6

The fact that we presuppose a linear demand explains the high elasticity we find in our study. In his meta-analysis, Espey (1998) finds that the use of linear demand functions brings about greater demand elasticity in the long run.

With this data, and having determined that the degree of tacit collusion in the market sets the stage for price reductions, we simulate their decrease and consequences on the autonomy's income through the wholesale hydrocarbon tax.

Specifically, using estimated coefficients for the demand and equilibrium equations, we will estimate the prices that may be obtained in the market if the conduct parameter were at the value predetermined by a *Cournot* level of competition.

From equilibrium equation (3), we predetermined Q_{ts} coefficient, i.e. $\frac{\theta}{\alpha_1}$. Given that $\theta = \lambda / N = 0.16$ in our case if we suppose a *Cournot´*s model, and the estimated values for α_1 are -74.18057 for La Palma, Fuerteventura and Lanzarote, and -1025.586 for Gran Canaria and Tenerife, we can reach that predetermined coefficient. The equations used are those obtained for both groups of islands.

As may be obvious, prices would decrease if competition increased. This reduction would provoke an increase in petrol consumption. This is in line with a tax collection increase on petrol-related products, in this case unleaded petrol (see Table 1). Table 7 demonstrates the loss of income the Canary Islands administration would have suffered in 2004 in the oligopoly islands (which consume more petrol).

INSERT TABLE 7

As we can see in the preceding table, in 2004 the Canary Islands Community lost almost one hundred million euros, amounting to about 39.1 percent of the total fiscal income derived from hydrocarbon taxation. This percentage increases to 58.1 percent if we only consider the unleaded petrol tax, which is the object of our analysis.

This result is not final, since the aim of the proposed model is not to estimate the function of petrol demand, but to derive it from the overall approximation of the equations that explain company performance in this market. Thus, the estimated elasticity value is far greater (for oligopoly islands) than that revealed by economic literature regarding the estimation of functions of hydrocarbon demand predicted at the retail level.

However, Table 8 shows how much income each island's Autonomous Community is losing, estimating different values of demand elasticity instead of using our model's demand characteristic. As we can see, the losses in fiscal income are significant.

INSERT TABLE 8

The loss of income varies between 1.86 and 9.28 percent of the total income from taxes on hydrocarbons if we use an elasticity of between -0.1 and -0.5 respectively. In absolute terms for the year 2004, it varies between 4.7 and 23.5 million euros, hardly a negligible sum for an Autonomous Community.

The percentage of relative losses increases if we consider the quantity collected by the Administration through unleaded petrol stations: within the range of 2.76 and 13.79 percent of the total, with conditioned elasticity.

7. Conclusions

There are three reasons that the petrol market is crucial to any economy: first, small consumers' intense demand for this type of product: second, it is a raw material for a large number of industries; third, because the tax system deems them an important source of income for any administration.

Just as in Spanish mainland, the Canary Islands petrol market is markedly concentrated, both in wholesale and retail distribution. This oligopolistic structure may accentuate the possible existence of collusive behaviours within the industry.

This study has two interrelated objectives within the framework of this sector: on one hand, to measure the existence of collusion (or lack thereof) in the Canary Islands retail petrol market, and on the other, to evaluate how sector competition affects the Autonomous Community's tributary income.

Our study is unique for various reasons. First, the causal link of our analysis is contrary to that applied in previous studies. We do not look at the effect taxes have on company and consumer behaviour. Rather, we measure the behaviours' effect on tributary income.

Additionally, our study focuses on the Canary Islands, a market which has not been previously studied. We offer two innovative advantages in the measurement of competition levels: greater ease in defining relevant geographic markets and the simultaneous presence of monopoly and oligopoly markets.

For the first objective, and in order to understand retail companies' behaviour in the Canary Islands market, we have followed Parker and Röller's (1997) method and, more recently, Jiménez and Perdiguero (2006b), for this same market. The latter is based on the estimation of companies' performance parameter in the presence of variations in the quantities offered by other companies. This means each company's objective should be to increase its market quota on each island. Our study does not create a model or a potential vertical integration between refinery and distributor, or the possible *Hottelling* horizontal competition.

Our data enables us to estimate a monopoly conduct of ($\theta = 1$), for those islands where such a market structure exists. On the other hand, the result obtained for the rest of the islands confirms the existence of a more collusive behaviour than corresponds to quantity-based, or *Cournot* competition, although without coinciding with the parameter for perfect collusion. Therefore, we can conclude that the deregulation process carried out all over Spain, where the Canary Islands present a greater tradition, does not seem to stimulate competition, in prices or quantities.

In light of the results regarding companies' performance, this study questions whether the behaviour of retail businesses in this market affects the Canary Islands Autonomous Community's income derived from the application of Law 5/1986 which regulates hydrocarbon taxing.

The decrease of the performance parameter to the level of *Cournot* competition, that is, equal to a parameter of 0.16 in our case, would mean a price reduction and an increase in quantity consumed. This would provoke an increase of tributary income of about one hundred million euros per year (estimate for 2004) in the Canary Islands.

Despite restrictions on the demand elasticity obtained in this model, if we reduce the value of such elasticity exogenously to values of traditional literature, loss of income would still be significant: at around 5 percent of the total taxes derived from hydrocarbons, and more than 8 percent if we only consider the income from unleaded petrol taxes.

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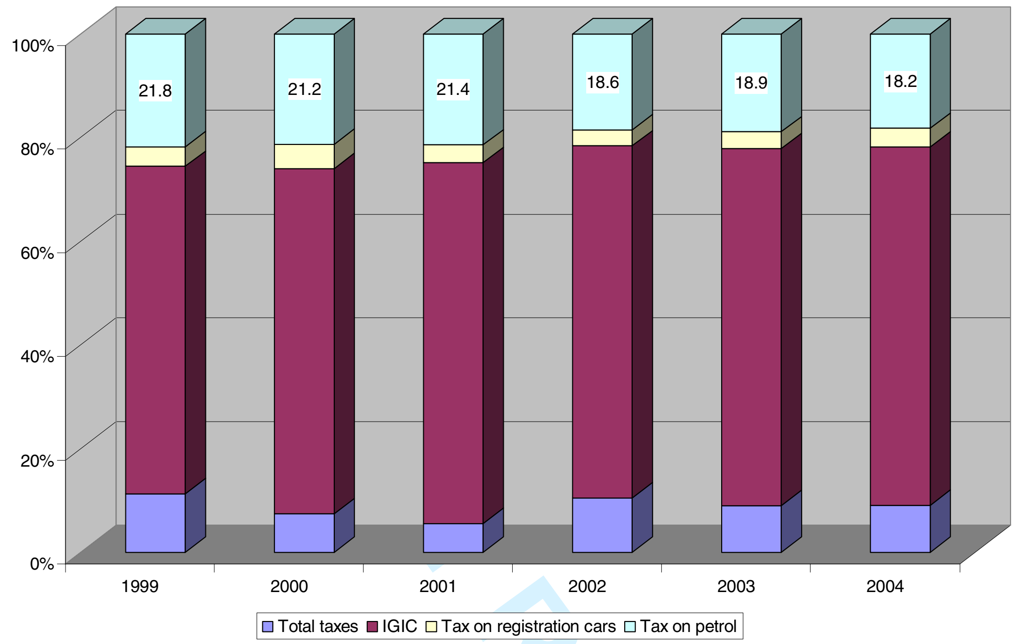
Graph and Tables.

Table 1. Type of duty applied depending on the product.

	Leaded Gasoline	Unleaded Gasoline	Gas-oil	Fuel-oil	Butane/propane
Type of fuel	232.24 /m^3	217.82 /m^3	102.66 /m^3	0.50 /Tm.	0.50 /Tm.

Source: Law 5/1986.

Graph 1. Distribution of total income from the Canary Islands Economic and Fiscal Regime (R.E.F.)



Source: Dirección General de Tributos. Government of Canary Islands. Own elaboration.

Table 2: Conduct parameter for monopoly islands (La Gomera and El Hierro)

	Parameter	z-Student
Demand		
Constant	429.452	4.59
P_{ts}	-3.878036	-1.88
$Population_{ts}+Tourist_{ts}$	0.0003451	0.12
Time	2.818836	1.86
R^2	0.9682	-
χ^2	1702.94	-
Equilibrium equation		
Constant	-31.57995	-0.70
Q_{ts}	0.2557958	1.40
$Gasolinespot_t+Transport_{ts}$	97.1314	8.20
R^2	0.4879	-
χ^2	107.09	-
Conduct Parameter		Chi2
θ	0.99	
θ=0	-----	7.12
θ=1	-----	0.00

Number of observations = 56; Number of iterations = 3

Table 3. Conduct parameter for oligopolistic islands.

	Parameter	z-Student
Demand		
Constant	35225.64	9.15
P_{ts}	-583.0267	-7.38
$Population_{ts}+Tourist_{ts}$	0.0014096	0.40
Time	388.727	8.62
R^2	0.9972	-
χ^2	28549.82	-
Equilibrium equation		
Constant	33.56599	7.55
Q_{ts}	0.0014041	1.32
$Gasolinespot_t+Transport_{ts}$	79.12528	21.56
R^2	0.9337	-
χ^2	1193.46	-
Parameter		Chi2
θ	0.81	
θ=0	-----	2.15
θ=(1/6)=0,16	-----	1.39
θ=1	-----	0.11

Number of observations = 80; Number of iterations = 3

Table 4. Conduct parameter for the islands: Lanzarote, Fuerteventura and La Palma.

	Parameter	z-Student
Demand		
Constant	8481.46	9.10
P_{ts}	-74.18	-3.21
$Population_{ts}+Tourist_{ts}$	-0.0003	-0.12
Time	52.9	3.56
R^2	0.99	-
χ^2	4473.60	-
Equilibrium equation		
Constant	-1.65	-0.05
Q_{ts}	0.01	1.39
$Gasolinespot_t+Transport_{ts}$	74.05	16.46
R^2	0.91	
χ^2	506.06	
Parameter		Chi2
θ	0.73	
θ=(1/6)=0,16	-----	2.52
θ=1	-----	0.55

Number of observations = 48

Table 5. Conduct parameter for the islands: Tenerife and Gran Canaria.

	Parameter	z-Student
Demand		
Constant	80297.09	4.83
P_{ts}	-1025.59	-8.15
$Population_{ts}+Tourist_{ts}$	0.0028	0.27
Time	678.86	8.25
R^2	0.97	-
χ^2	1083.66	-
Equilibrium equation		
Constant	17.13	0.89
Q_{ts}	0.00075	1.15
$Gasolinespot_t+Transport_{ts}$	81.41	17.58
R^2	0.97	-
χ^2	331604.42	-
Parameter		Chi2
θ	0.77	
θ=(1/6)=0,16	-----	0.98
θ=1	-----	0.71

Number of observations = 32

Table 6. Demand elasticities in the short-run.

Author and publication year.	Year	Data	Country	Demand elasticity
Bohi and Zimmerman (1984)	-	-	(*)	0.0/-0.77
Dahl (1986)	-	-	(*)	-0.29
Dahl and Sterner (1991)	1960-1985	Time series	France	-0.36
Dahl and Sterner (1991)	1960-1985	Time series	Italy	-0.37
Dahl and Sterner (1991)	1960-1985	Time series	Spain	-0.14
Goodwin (1992)	-	-	(*)	-0.27
Espey (1998)	-	-	(*)	-0.23
Labandeira and López (2002)	1986-1995	Cross Section	Spain	-0.08
Present paper	2003-2004	Panel Data	Canary Islands	-0.76/-1.7

Source: Own elaboration based on Graham and Glaister (2002). (*) Is the average of different demand elasticities for different geographic markets.

Table 7. Simulation of tax losses in the oligopolistic islands. Year 2004. (Euros)

Island	Year lost ( )
Lanzarote	6,846,147.37
Fuerteventura	4,351,621.93
Gran Canaria	37,118,447.63
Tenerife	47,742,037.01
La Palma	3,069,309.55
Total	**99,127,563.48**
% of total hydrocarbon taxes	**39.1**
% of unleaded gasoline taxes	**58.1**

Source: Own elaboration.

Table 8. Simulation of tax losses in the oligopolistic islands, with different demand elasticities. Year 2004. (Euros)

Island	$\varepsilon = -0.1$	$\varepsilon = -0.2$	$\varepsilon = -0.3$	$\varepsilon = -0.4$	$\varepsilon = -0.5$	$\varepsilon = -1.0$
Lanzarote	686,759.83	1,373,519.65	2,060,279.47	2,747,039.3	3,433,799.13	6,867,598.25
Fuerteventura	278,902.42	557,804.84	836,707.26	1,115,609.69	1,394,512.12	2,789,024.23
Gran Canaria	1,366,347.19	2,732,694.38	4,099,041.57	5,465,388.77	6,831,735.96	13,663,471.9
Tenerife	2,221,392.18	4,442,784.37	6,664,176.56	8,885,568.75	11,106,960.9	22,213,921.9
La Palma	149,964.11	299,928.22	449,892.33	599,856.45	749,820.56	1,499,641.13
Canary Island	**4,703,365.74**	**9,406,731.48**	**14,110,097.2**	**18,813,463**	**23,516,828.7**	**47,033,657.4**
% of total hydrocarbon taxes	1.86	3.71	5.57	7.42	9.28	18.55
% of unleaded gasoline taxes	2.76	5.52	8.27	11.03	13.79	27.58

Source: Own elaboration.