Natural Gas market in Spain before market liberalization

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ABSTRACT:

In this paper we analyze the natural gas market in Spain as a no liberalized market by means of oligopoly models. We use a generalized Stackelberg model, Watt model, which considers a general number both activity levels and companies in each level. We will see that this model is more appropriated than the classical oligopoly models to the characteristics of the market. We will discuss supposing three different scenarios. We will compare market shares that theoretical model predicts, in each of the different scenarios, with real market shares obtained from the CNE. Finally, we will study which of the scenarios is most appropriate and whether, given this scenario, our market is moving towards or away from the theoretical equilibrium position.

KEYWORDS:

Oligopoly, gas market, generalized Stackelberg model.

1. INTRODUCTION

In this paper we analyze the Natural Gas market in Spain before market liberalization from the point of view of oligopoly theory, comparing the actual data from the National Energy Commission (CNE) with the theoretical equilibrium predicted by a generalized Stackelberg model (Watt model).

First, we review the traditional oligopoly models, which can be classified into price competition (Bertrand) and quantity competition (Cournot and Stackelberg), and we will conclude that such models are ineffective for analyzing our market. The main reason we discard traditional oligopoly models is that these models predict different market shares only for firms with different marginal cost structure and the main feature we can highlight in the Natural Gas market in Spain is that there are a variety of companies operating in the sector with very different market shares but very similar marginal cost structure.

Thus, one fundamental objective of our work is to find an oligopoly model suitable with our market characteristics that allow us to analyzed, through the

data, if the market shares approach their natural positions of equilibrium. We will consider several scenarios, which we will compare with the real situation. We will see how the use of a more general oligopoly model is more effective to describe the activity of the market than any other traditional oligopoly model. We will pay close attention to a generalized Stackelberg model proposed by Watt (2002) in his article ¨*A generalized Oligopoly Model*¨, that we call so on Watt model,, where the industrial structure has different activity levels and a general number of companies in each level.

Although this model is somehow restrictive, due to the simplifying assumptions of linear demand and constant marginal costs for all companies operating in the market, these hypotheses are consistent with the natural gas market in Spain, since we can assume in this market that demand is locally linear and marginal costs are constant and equal.

The Watt model has been applied to the study of the electricity market (Contreras (2011)) as well as the fuel market (Watt (2003)). However, despite many similarities can be drawn between the latter market analysis and ours, to our knowledge, it has not been previously applied to the natural gas market.

In our study, we focus on the period 2007-2008, where theoretical equilibrium quotas will be calculated and compared with the real ones obtained through data published by the CNE. Through a various scenarios approach, we will see if the market is close, or not, to the theoretical equilibrium.

For a better development of the objectives, this paper is structured in six sections. After the introduction, we analyze oligopoly models in economy with special emphasis on the Cournot model (section 2). In section 3, we analyze the natural gas market in Spain before market liberalization. In section 4, we study in detail the Watt model, as a generalized Stackelberg model, which will be the base of our work. In section 5, we apply this model to the study of the natural gas market in Spain during the eight quarters of years 2007-2008 and in the last section we present some concluding remarks.

2. CLASSIC OLIGOPOLY MODELS

Oligopolistic structures are characterized by the existence of a few companies whose dimension gives them some market power. That occurs when, by itself and independently, a company is able to raise prices or reduce output below the competitive level of the market in order to increase its profit.

Following C. Shapiro (1989), traditional models of oligopoly can be divided into two classes: models of price competition (Bertrand model) and models of quantity competition (Cournot and Stackelberg models).

The Bertrand model is based on the assumption that firms compete on the price at which they offer their production (price competition). In Bertrand equilibrium, when companies have identical marginal costs and their products are homogeneous, prices tend to marginal cost and each firm have an equal market share.

In the Cournot model all companies compete setting quantities (quantity competition). The Cournot equilibrium is reached when the production of each firm is optimal considering other companies production as a constant. In equilibrium, each firm have an equal market share and receive the same benefit, which is larger than in the Bertrand case.

The Stackelberg model is a leader-follower oligopoly model. All companies but one work assuming that other companies production is constant (follower firms). The remaining company acts a little more sophisticatedly and assumes that its production conditions the production of the rest (leader firm). As in previous models, all companies, including the leader, have the same cost function. In equilibrium each follower firm produces an identical amount and has the same market share. However, the leader firm produces more than any follower and gets the largest market share and profit.

For its importance in the subsequent development of our study, it is necessary to point out some facts of the Cournot equilibrium and their

implications in the market share structure of firms. The model considers there are n firms operating in the market and it includes the following assumptions:

- The price at which companies sell depends on the total production of the marker through the inverse demand function. $p = D(X)$, where X is the total market output.
- Price-elasticity of demand is constant and is denoted by μ.
- If we denote by x_i the quantity produced by firm i, then the total production is $X = \sum_{i=1}^{n} x_i$
- Each firm i has a cost function denoted by $c_i(x_i)$ $\forall$ i= 1, …, n.

So, the profit function of firm i is:

$$\pi_i = x_i p - c_i(x_i) \quad \forall \, i = 1, \dots, n$$

In order to calculate the optimal production of each firm i, we note that the profit function can be regarded as a strictly concave function and, therefore, it is sufficient to apply the first-order condition for a local optimum. This condition implies that the marginal benefit is zero:

$$\pi_i'(x_i) = 0 \quad => \quad p + x_i \frac{dp}{dX}\frac{dX}{dx_i} = c'_i(x_i)$$

Note that this expression can be rewritten as:

$$p + \frac{x_i}{X}\frac{X}{p}p\frac{dp}{dX}\frac{dX}{dx_i} = c'_i(x_i)$$

If we denote by $m_i = \frac{x_i}{X}$ the relative market share of firm i and consider that the inverse of the price-elasticity of demand is $\frac{1}{\mu} = \frac{X}{p}\frac{dp}{dX}$, we have:

$$p\left[1 + m_i \frac{1}{\mu}\frac{dX}{dx_i}\right] = c'_i(x_i)$$

Since $\frac{dX}{dx_i} = 1 + \sum_{j \neq i}\frac{dx_j}{dx_i}$ and in a Cournot model $\frac{dx_j}{dx_i} = 0$ for all i≠j, we have $\frac{dX}{dx_i} = 1$, and, therefore:

$$p\left[1 + \frac{m_i}{\mu}\right] = c'_i(x_i) \quad (1)$$

So, the relative market share of firm i is given by the following expression:

$$m_i = \frac{\mu c'_i(x_i)}{p} - \mu \qquad (2)$$

Since price (p) depends only on the amount produced by the demand function and the price-elasticity of demand is constant, expression (2) implies that in equilibrium market shares can only differ between companies when they have different marginal costs.

Nevertheless, the reality of many industries is very different: firms have different market shares, and sometimes there are no two firms with equal market shares, despite they have the same cost function. In next section, we will discuss the natural gas market in Spain and the reasons that classical models fail.

3. NATURAL GAS MARKET IN SPAIN

In this section we describe the relevant characteristics of the natural gas market in Spain before market liberalization.

This market, with about fifteen companies with different market shares, can be considered as an example of oligopolistic market. The biggest company has a 45% market share (Gas Natural Group), the second and third companies have market shares between 12% and 15% (Iberdrola and Fenosa Group). Other companies do not exceed individually a 10% market share.

As an example, Figure 1 shows information related to the fourth quarter of 2008 respectively. Complete information on the four quarters of 2007 and 2008 can be found in Table 1, which displays the real percentage shares of the different companies operating in the market ("Rest" grouping includes companies with shares between 0.5% and 1%).

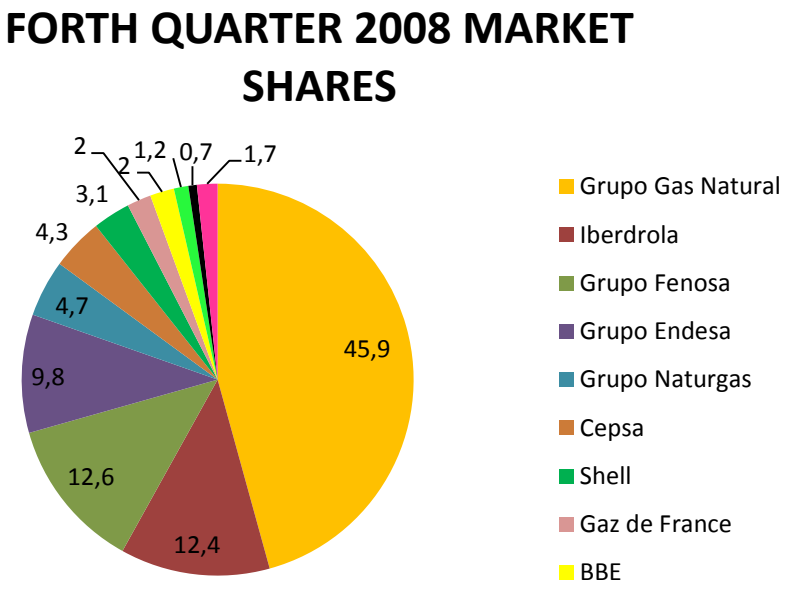

Figure 1: 4th quarter 2008 percentage market shares percentage (from CNE and authors' elaboration).

	2007				2008			
100 mi	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
GRUPO GAS NATURAL	48,8	45,3	45,2	46,9	44,7	42,6	41,3	45,9
IBERDROLA	11,1	12,3	13,8	14,2	11,9	14,8	14,9	12,4
GRUPO FENOSA	12,8	15,7	14,6	13,7	13,2	13,1	13,1	12,6
GRUPO ENDESA	9,1	8,7	8,1	8,6	9,3	8,7	9,2	9,8
GRUPO NATURGAS	4,8	4,9	4,2	4,5	6	5,5	5,1	4,7
CEPSA	4	4,7	4,9	4,2	4,8	4,1	4,6	4,3
SHELL	3,2	3	3	2,3	3,6	3,1	3,7	3,1
GAZ DE FRANCE	2,7	2,8	2,6	2,7	2,6	2,7	2,4	2
BBE	2,6	1,8	2,9	2,2	2,1	2,1	2,6	2
ENEL VIESGO GENERACION					1	1,1	1,3	1,2
BP	0,8	0,8	0,5	0,4	0,4	1,5	1,1	0,7
REST (2007* y 2008)**	0,2	0,1	0,3	0,3	0,4	0,7	0,8	1,7

Table 1: Quarterly market shares as a percentage (from CNE and authors' elaboration).

* INCOGAS, CÉNTRICA Y NEXUS <1%
** INCOGAS, CÉNTRICA, NEXUS, EGL, GALP ENERGÍA <0,5%

In the Natural Gas market in Spain before liberalization the price was strongly regulated, so a Bertrand-type model with price competition is excluded as an explanation for the sector structure. As we saw in the previous section, in a Cournot equilibrium market shares only can differ between companies when they have different marginal costs. Since companies reach different market shares with similar marginal costs, we can rule out the Cournot model as a model to describe and analyze the natural gas market in Spain.

In the Stackelberg model, all companies but one behave in the same way. Since the other company acts as a leader, this is the only one who can have a different market share. As we prove in Section 2, the only theoretical explication for a wide range of market shares would be different marginal cost functions. However, the marginal cost of any activity depends directly on the way in which the activity is performed and, in the case of natural gas, there are no major differences between the various companies operating the market. So, we assume they have the same cost structure and look for a model including a wide range of market shares companies with similar marginal costs.

4. THE WATT MODEL

In the classical Cournot model, all firms behave equally and there is only one level of activity. In classical Stackelberg model all firms produce a homogeneous good in a non-cooperative way, but there is only one that acts differently and so there are two levels of activity (the leader and the followers).

The Stackelberg model has been generalized in different ways. On one hand, the number of companies in each level has increased. The first model to change the existence of a single leader is the one proposed by Sherali (1984) which considers a situation with a general number of leaders and followers. In both levels, companies assume that the production of the rest of companies in the level is fixed (it is said they have Cournot beliefs regarding production of other companies in the level). However, companies in the first level act as Stackelberg leaders regarding the follower companies. In equilibrium, each leader produces more and gets a largest profit than the follower firms but within

each of the two levels of activity each company in the level has the same market share. On the other hand, the traditional model has been generalized to include more than two levels of activity but with only one company in each level. Several articles can be found in which it is used different definitions of level. For example, Hamilton and Slutsky (1990), Anderson and Enders (1992) and Matsumura (1999).

However, none of these papers considers a model with a general number of levels and a general number of firms in each level. This was first done in Watt (2002). The model proposed in the paper, Watt model, point out that the only difference between companies is regarding their beliefs (although such beliefs can be supported by major economic issues) and it takes into account both, a general number of levels of activity and a general number of companies in each level. This generalization is done in such a way that the hierarchy of firms beliefs provide an explanation for cases where there is a wide range of market shares that cannot be explained by differences in marginal costs.

In Watt model, it is considered a price-inelastic linear demand, as well as equal constant marginal costs for all companies operating in the market. Both assumptions are suitable in our case since there is no substitute for natural gas and all companies in the market use similar technology. So, we are now going to discuss theoretically this model in order to find a market equilibrium that allows us to study the inherent market share structure.

- There are z different activity levels, with n_k firms in level k; $\forall k = 1, \dots, z$; the total number of firms will be, therefore, $n = \sum_{k=1}^{z} n_k$.
- Firms in level k act as followers of all firms in levels j<k and as leaders of all firms in levels j>k. Firms within the same level play a Cournot game between them. Therefore, companies in level z (last level) are followers with respect to companies in the rest of levels. By contrast, companies in level 1(first level) are leaders regarding companies in the rest of levels.

- If we denote by X^k the total production of the level k and by x_i^k the production of firm i which is located at level k we have

$$X^k = \sum_{i=1}^{n_k} x_i^k$$

So, the aggregate demand is $\mathrm{X} = \mathrm{X}^1 + \mathrm{X}^2 + \cdots + \mathrm{X}^z$

- All companies, regardless of level they are in, have the same cost function, which is considered proportional to the quantity produced:

$$\mathrm{C}\left(\mathrm{x}_\mathrm{i}^\mathrm{k}\right) = \mathrm{c}.\,\mathrm{x}_\mathrm{i}^\mathrm{k} \quad \forall \mathrm{i} = 1, \dots, \mathrm{n}_\mathrm{k}; \quad \forall \mathrm{k} = 1, \dots, \mathrm{z}$$

- The inverse demand function is given by the following linear expression,

$$p = a - bX \quad \text{con } a, b > 0$$

where p is the uniform price that all companies sell their products.

Once established the assumptions of Watt model, the profit function for firm i located at level k is given by:

$$\pi_i^k = px_i^k - cx_i^k = x_i^k(a - bX - c) =$$
$$= x_i^k(a - b(X^1 + \cdots + X^{k-1} + X^k + X^{k+1} + \cdots + X^z) - c) =$$
$$= x_i^k[(a - b(X^1 + \cdots + X^{k-1}) - b(X^k + X^{k+1} + \cdots + X^z) - c]$$

If we denote the inverse of aggregate demand up to the level k-1 by $a_k = a - b(X^1 + \cdots + X^{k-1})$ for $k \geq 2$ and $a_1 = a$, our profit function can be expressed as:

$$\pi_i^k = x_i^k \left[a_k - b\left(X^k + \sum_{j=k+1}^{z} X^j \right) - c \right]$$

In order to calculate the equilibrium share of firm i at level z (last level) we are going to use the inverse demand function at level z, given by $p_z = a_z - bX^z$. Within this level a_z does not depend of X^z and we have $\frac{dp_z}{dX^z} = -b$. The price-elasticity of the demand is constant and, therefore,

$$\frac{1}{\mu} = \frac{X_z}{p_z}\frac{dp_z}{dX^z} = \frac{-bX^z}{p_z}$$

At level z, firms are in a Cournot game between them. So, from the expression obtained in (1) for Cournot equilibrium, with $c_i'(x_i^k) = c$, we have:

$$p_z\left[1 + (\frac{-bX^z}{p_z})\frac{x_i^z}{X^z}\right] = c$$

Replacing p_z by its value and taking into account that in a Cournot game all production quotas are equal ($X^z = n_z x_i^z$), after operating and simplifying, we obtain that the equilibrium market share of firm i at level z is:

$$x_i^{z*} = \frac{a_z - c}{b(n_z + 1)}$$

It can be shown by backward induction (see Watt (2002) for details), that equilibrium market shares at any higher level k follow the same structure:

$$x_i^{k*} = \frac{a_k - c}{b(n_k + 1)} \qquad \forall k = 1, \dots, z \qquad (3)$$

From (3) we obtain that the equilibrium share for any firm i within level 1 is:

$$x_i^{1*} = \frac{a_1 - c}{b(n_1 + 1)} = \frac{a - c}{b(n_1 + 1)} \qquad (4)$$

Likewise, the equilibrium share for any firm i within level 2 is:

$$x_i^{2*} = \frac{a_2 - c}{b(n_2 + 1)} = \frac{a - bX^1 - c}{b(n_2 + 1)} \qquad (5)$$

Since all companies within level 1 are playing a Cournot game between them, they have the same theoretical market share with $X^1 = n_1 x_i^1$. So, substituting in equation (5) the value x_i^1 obtained from the expression (4), it follows that:

$$x_i^{2*} = \frac{a - c}{b(n_2 + 1)(n_1 + 1)}$$

In this case it is necessary to proceed by forward induction to obtain the equilibrium share for any firm i located at level k, which is given by the following expression:

$$x_i^{k*} = \frac{a-c}{b\left[\prod_{j=1}^{k}(n_j+1)\right]} \qquad \forall k = 1,2,3,\dots,z \qquad (6)$$

Therefore, total production in all levels is:

$$X^* = \sum_{k=1}^{z} n_k\, x_i^{k*} = \frac{(a-c)}{b}\sum_{k=1}^{z}\left[\frac{n_k}{\prod_{j=1}^{k}(n_j+1)}\right]$$

This allows us to calculate the relative market share in equilibrium for any firm i located at level k, by the following expression:

$$m_i^{k*} = \frac{x_i^{k*}}{X^*} = \frac{\dfrac{a-c}{b\left[\prod_{j=1}^{k}(n_j+1)\right]}}{\dfrac{(a-c)}{b}\sum_{k=1}^{z}\left[\dfrac{n_k}{\prod_{j=1}^{k}(n_j+1)}\right]} \qquad (7)$$

By simplifying, we can see that this share does not depend on the model parameters (a, b and c) and can be expressed as:

$$m_i^{k*} = \frac{1}{\prod_{j=1}^{k}(n_j+1)\sum_{k=1}^{z}\left[\dfrac{n_k}{\prod_{j=1}^{k}(n_j+1)}\right]} \qquad (8)$$

After some algebraic calculation, it is possible to obtain a more compact expression, which is the one we will use to obtain theoretical relative market shares in our study of the natural gas market in Spain, developed in Section 5:

$$m_i^{k*} = \frac{\prod_{j=k+1}^{z}(n_j+1)}{\prod_{j=1}^{z}(n_j+1)-1} \quad \forall\, k = 1,\dots,z \qquad (9)$$

5. WATT MODEL AND THE NATURAL GAS MARKET IN SPAIN

In this section we apply the Watt model developed in the previous section to the natural gas market in Spain. As mentioned above, we will analyze the market on a quarterly basis for the years 2007 and 2008, considering separately each of the major companies but grouping the companies with a market share between 0.5\% and 1\% in a heading called Rest.

In 2007 there are 10 companies with a significant market share, which means that in our study the total number of firms is n = 11, even though Rest firm consists of three companies: Incogas, Céntrica and Nexus. In 2008 Enel Viesgo Generacion (EVG) enter into the market. So, in this year there are 11 companies with a significant market share and this means that in our study the total number of firms is n = 12, even though Rest consists of five companies: Incogas, Céntrica, Nexus, EGL[1] y Gap Energía.

The fundamental reason why several companies have been grouped under heading Rest is that all of them have individual market shares below 1% but as a whole control a significant market share. It must be noted that the biggest one of these companies has a market share that is less than the last one included individually, in our case BP in 2007 and Enel Viesgo generation for 2008 (see Table 1 presented in Section 3 for relative market shares of the different companies operating in the market, which are denoted by m_i and displayed in percentage form as $100m_i$).

Let us recall that in Watt model firms are divided into z levels with n_k companies within level $k = 1, \dots, z$, and, therefore, the total number of firms is $n = \sum_{k=1}^{z} n_k$.

At first view, the analysis of real market shares shows clearly a company differentiated from the rest (Gas Natural Group), a second group of companies with a market share of around 10\%, a third group of companies with shares

[1] EGL (European Gas Limited).

ranging between 5\% and 2\%, and finally, a group composed of companies with smaller market shares.

Therefore, in all of three possible scenarios proposed Natural Gas Group appears alone within level 1. The other levels are formed by a different composition of companies depending on the scenario under consideration.

SCENARIO A: It is a four-level situation, with Gas Natural Group in the first level, three companies in the second level (Iberdrola, Fenosa and Endesa Group), five companies in the third level (Naturgas Group, Cepsa, Shell, Gaz de France and BBE[2]) and a fourth level with different companies depending on year. In 2007 there are two companies in the fourth level (BP and Rest) and in 2008 EVG is incorporated to this level (remember that Rest is different in 2007 and 2008).

SCENARIO B: It is a five-level situation, with the same two first levels as before. The former third level is split here in two new levels: level 3 (Group Naturgas and Cepsa) and level 4 (Shell, Gaz de France and BBE). The fifth level is the final level 4 from scenario A.

SCENARIO C: It is a five-level situation that comes from scenario A when we split the second level considering Grupo Endesa individually as a single level.

As we saw at the end of section 4, relative theoretical market share of firm i located at level k (m_i^{k*}) in equilibrium is expressed as:

$$m_i^{k*} = \frac{x_i^{k*}}{X^*} = \frac{\prod_{\mathrm{j=k+1}}^{\mathrm{z}}(\mathrm{n_j}+1)}{\prod_{\mathrm{j=1}}^{\mathrm{z}}(\mathrm{n_j}+1)-1} \qquad \forall\, k = 1, \dots, z \qquad (9)$$

Table 2 shows the theoretical percentage shares of companies operating in the market $(100m_i^{k*})$, which have been obtained by equation (9).

[2] BBE (Bahía de Bizkaia Electricidad).

	2007			2008		
$100m_i$	A	B	C	A	B	C
GRUPO GAS NATURAL	50,35	50,17	50,23	50,26	50,13	50,17
IBERDROLA	12,59	12,54	16,74	12,57	12,53	16,72
GRUPO FENOSA	12,59	12,54	16,74	12,57	12,53	16,72
GRUPO ENDESA	12,59	12,54	8,37	12,57	12,53	8,36
GRUPO NATURGAS	2,10	4,18	1,40	2,09	4,18	1,39
CEPSA	2,10	4,18	1,40	2,09	4,18	1,39
SHELL	2,10	1,05	1,40	2,09	1,04	1,39
GAZ DE FRANCE	2,10	1,05	1,40	2,09	1,04	1,39
BBE	2,10	1,05	1,40	2,09	1,04	1,39
BP	0,70	0,35	0,47	0,52	0,26	0,35
ENEL VIESGO GEN.				0,52	0,26	0,35
RESTO	0,70	0,35	0,47	0,52	0,26	0,35

Table 2: Theoretical shares for all considered scenarios as a percentage (authors' elaboration).

In order to assess whether our theoretical scenarios approach the real situation, we measure the difference between actual and theoretical data. The index used is the absolute value of the distance between the actual data and the theoretical data, weighted by the size of the company in the sector. To avoid confusion, the actual relative share of firm i within level k is denoted by m_i^k, while the theoretical one is denoted by m_i^{k*}. So, this index is given by:

$$D(z,n) = \sum_{k=1}^{z} \sum_{i=1}^{n_k} m_i^k \left| m_i^{k*} - m_i^k \right|$$

Table 3 shows percentage value of this index, $100D(z,n)$, in every proposed scenario and for each of the quarters of 2007 and 2008.

	2007				2008			
100D(z,n)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Escenario A	1,538	3,463	3,443	2,564	3,39	4,34	4,796	2,58
Escenario B	1,372	3,253	3,272	2,383	3,194	4,189	4,645	2,405
Escenario C	2,292	3,398	3,429	2,693	4,146	4,483	4,99	3,552

Table 3: Distance index between actual and theoretical data as a percentage (authors' elaboration).

In our study we consider Scenario B as more representative because it is the one with a lower index in all four quarters of the two years analyzed, which ranges from 1,372 for the first quarter of 2007 to 4,645 for the third quarter of 2008. So, and now on, we will focus the analysis on Scenario B, comparing the actual data presented in Table 1 with the theoretical results obtained under Scenario B and displayed in Table 2.

- In level 1, both years Gas Natural Group has about a 46% market share. It is slightly below its natural position of equilibrium, which would be around 50%. (See Figure 2).

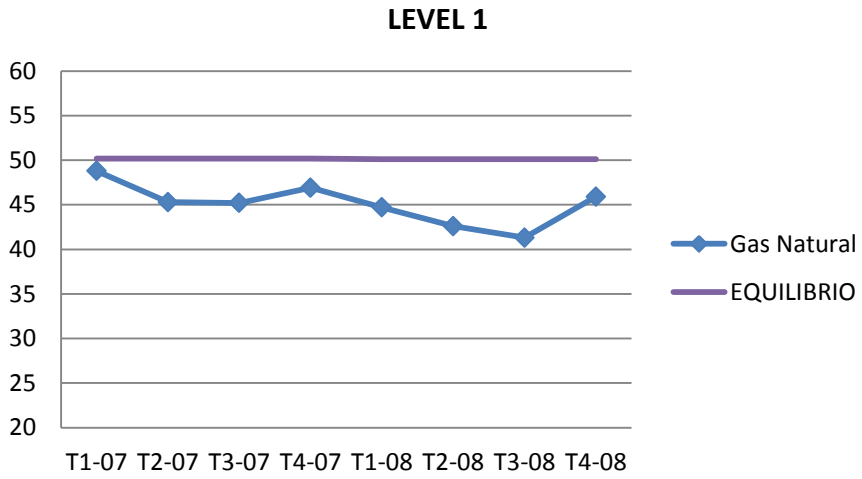

Figure 2: Actual market shares versus equilibrium (level 1).

- In level 2, Iberdrola and Fenosa Group move around his natural position of equilibrium, finishing the fourth quarter of 2008 with a market share very similar to its theoretical one. However, Endesa Group is 3.9 points below its theoretical position of equilibrium. We can see that in the fourth quarter of 2007 it has a share of 8.6% and ends the fourth quarter of 2008 with a market share of 9.8%. Maybe, it could be approaching to his natural position of equilibrium (see figure 3).

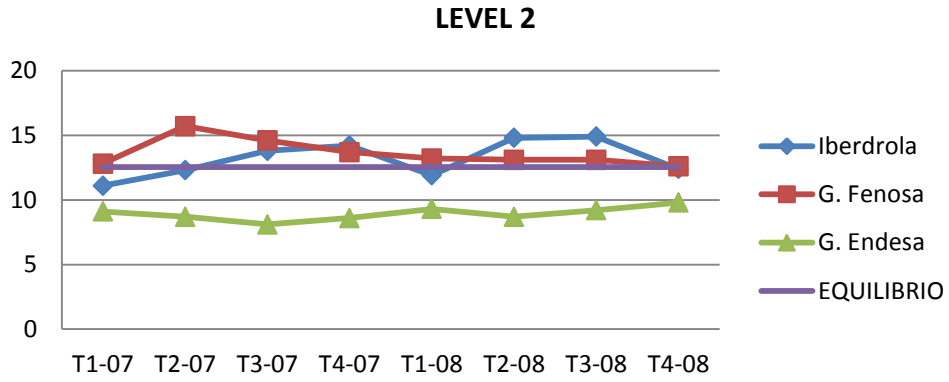

Figure 3: Actual market shares versus equilibrium (level 2).

- In level 3, Naturgas and Cepsa Groups are both years fairly close to his theoretical position of equilibrium, especially in the case of Cepsa (See Figure 4).

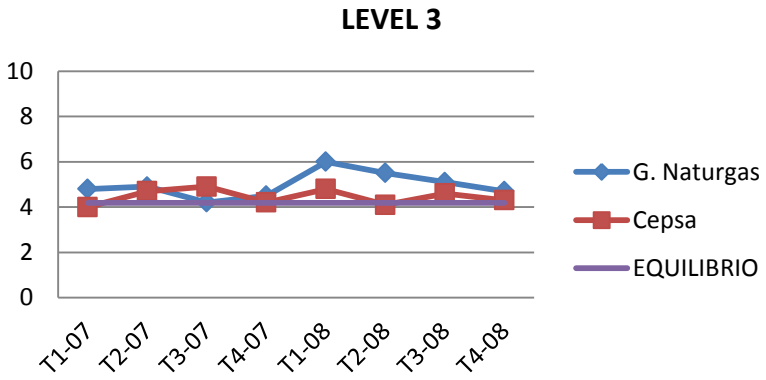

Figure 4: Actual market shares versus equilibrium (level 3).

- In level 4, Shell, Gaz de France and BBE are in 2007 and 2008 a little above their natural position of equilibrium, being Shell the farthest. We can observe that Gaz de France and BBE evolve slowly towards its theoretical equilibrium position, while the distance between this equilibrium position and Shell's position increases in 2008, with Shell always moving far from its equilibrium position (See Figure 5).

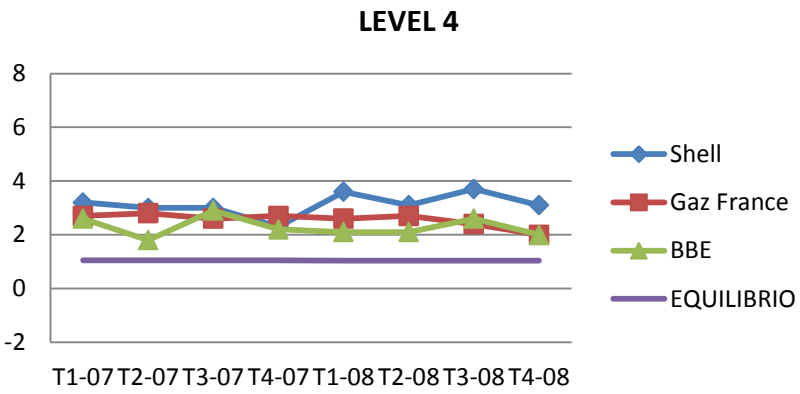

Figure 5: Actual market shares versus equilibrium (level 4).

- Finally, in Level 5, we can observe that BP ends the fourth quarter of 2007 close to its theoretical position of equilibrium, while during 2008 it slowly moves away from equilibrium. In 2008 Enel Viesgo Generación (EVG) enters into the Spanish market and ends in 2008 only a 0.5% above its theoretical position of equilibrium.

  The heading "Rest" deserves further analysis because its composition changes from 2007 to 2008. In 2007 we observed that it ends the fourth quarter of the year in an equilibrium position. However, all over 2008 is above this equilibrium position and ends the fourth quarter with a 1.7% share, which is far from its 0.26% theoretical equilibrium share.

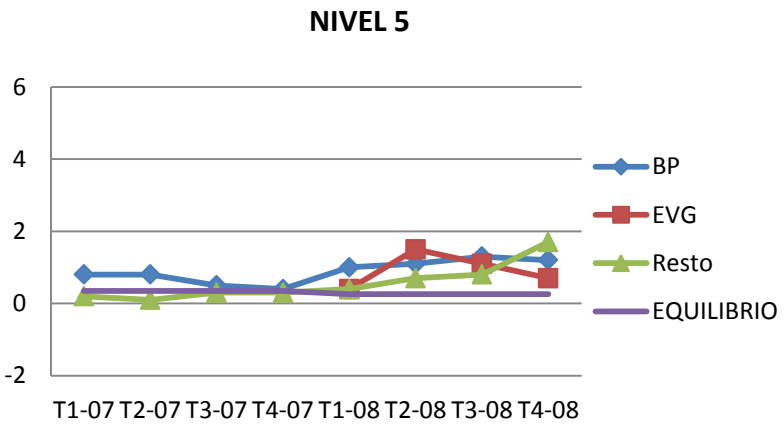

Figure 6: Actual market shares versus equilibrium (level 5).

6. CONCLUSION

In this paper we have studied the natural gas market in Spain during the eight quarters of years 2007 and 2008, taking into account that during the last year it was changes in the composition of the market, since EVG entered into the Spanish market in 2008.

One objective was to check whether the traditional models of oligopoly of Bertrand, Cournot and Stackelberg are adequate to reflect the characteristics of this sector and we have seen that none of them is adequate. In the first model there is price competition, which is not possible in our case because natural gas prices were regulated in Spain in those years. So that the other two models were adequate there would be equal market shares for all companies, but one in Stackelberg model (corresponding to the leader). However, there are significant differences between them.

In this sense, the so-called Watt model is more appropriate for analyzing our market, even though, we have considered for the sake of simplicity a linear market demand and equal constant marginal costs for all companies operating in the market. As in the model the companies are structured in different levels, it is possible that companies have a different market share, which is determined by this structure.

In our study, we have determined the market structure considering three possible scenarios for which we have compared the actual data (obtained through CNE) with the theoretical data (obtained after applying the model). The choice of the most adequate scenario has been made calculating an index of distance between actual and theoretical data in all of the three considered scenarios.

The structure that seems to be more appropriate is the one in which the companies are distributed in five different activity levels. On the first level is the Gas Natural Group as the absolute leader. The second level consists of Iberdrola, Fenosa and Endesa groups. The third level is composed by Naturgas

and Cepsa groups and the fourth by Shell, Gaz de France and BBE. In the last level are the companies with lower market share (integrated into the heading “Rest”) joined to BP in 2007 as well as EVG in 2008.

Once the market structure was identified, we analyzed whether the theoretical positions of the companies within the sector in an equilibrium position correspond to the positions they actually occupied. Endesa Group is the company that is farthest from its equilibrium position, though; we can guess that Endesa Group gradually approaches to the equilibrium position in the relevant range. Also, the company Shell, located on the fourth level, was away from its equilibrium position in 2008. The discrepancies may be due to the simplifying assumptions of our theoretical model (linear demand and constant marginal cost and identical for all firms), the fact of considering the companies grouped under the heading “Rest” of equal size, and aspects of the competition not represented in the model (specials promotions, pricing policies, location of distribution and marketing centers in areas of high economic activity, ...).

So, we have found that, in general, the proposed model is suitable for studying the natural gas market in Spain as a no liberalized market, in spite of the discrepancies already identified. The market liberalization leaves for further analysis if the new market composition can also be structured in different levels with companies whose market shares are close to an equilibrium position.

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