# MERGERS, DIFFERENCE-IN-DIFFERENCE AND CONCENTRATED MARKETS: WHY FIRMS DO NOT INCREASE PRICES?[1]

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**Abstract**

Difference-in-Difference (DiD) methods are increasingly used in analyzing the impact of mergers on pricing and other market equilibrium outcomes. Using the evidence from an exogenous merger between two, retail gasoline companies in a specific market in Spain, this paper shows how concentration did not cause a price increase. In fact, the conjectural variation model concludes that the existence of a collusive agreement before and after the merger explains this result, not the existence of efficient gains. For this reason, it is recommended that a conjoint and multilateral effects analysis on merger cases, be conducted.

**Keywords:** Mergers, Gasoline Market, Difference-in-Difference, Conjectural Variation

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## 1. Introduction

There is no one way to evaluate a merger. Authorizing mergers requires the prediction of the participants' future conduct, which complicates the analysis and gives relative importance to the industry's structure and results during the merger process.

As Weinberg (2008) points out, three main approaches have been used to try to measure the effect of mergers on prices: case studies, simulation of mergers, and direct comparisons of prices before and after the process of concentration. The first two approaches introduce an array of assumptions that may be vital to the result of the analysis. As Peters (2006) demonstrates, the results are very sensitive to the assumptions about demand, costs, and the market's competitive equilibrium.

The direct comparison of prices, before and after the merger, offers a much more flexible framework for analysis. For this reason, the number of articles using this approach – the Difference-in-Difference (DiD) estimator – to analyze the effect of the mergers has grown in recent years.

It is worth pointing out that most of the articles using this methodology have found that, due to the merger processes, prices increase. Examples, where significant price increases due to mergers were found, are: Barton and Sherman (1984) in microfilm production; Borenstein (1990) and Kim and Singal (1993) in the North American air travel market; and McCabe (2002) in the publishing of scientific reviews. In the banking sector, Prager and Hannan (1998) and Focarelli and Panetta (2003) found that after a merger, savers are rewarded with lower interest rates.[4] Vita and Sacher (2001) noted that even non-profit-making hospitals increase prices after a process of concentration and Dafny (forthcoming) finds the same result for profit-hospital mergers. By contrast, Connor, Feldman and Dowd (1998) found a reduction in costs and prices after the merger carried out by United States' hospitals. In rail transport, Karikari, Brown and Nadji (2002) also noted reductions in prices, although this result depended on the type of goods, the traffic direction, and the type of transport. Ashenfelter and Hosken (2008) analyzed the effect of mergers, in terms of prices, on five different industries: hygiene products for women, alcoholic drinks, lubricating oil, cereals, and breakfast syrups. All except breakfast syrups showed significant price increases.[5]

Although the aforementioned industries show post-merger price increases, the results for gasoline are completely different. Taylor and Hosken (2007) analyzed the effect of joint ventures between the companies, Marathon and Ashland, which resulted in greater concentration and a significant change in the existing vertical change within the market.

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[4] Sapienza (2002) finds that the effect on loan contracts depends on the merger banks' size. If the firms have an important market share, the interest rate increases, if they have a smaller market share, the interest rate decreases.

[5] See Weinberg (2008) for more detailed explanations of most of the previous analyses.

The authors concluded that this process of concentration had no significant effects on the final prices. In this same market, Simpson and Taylor (2008) analyzed the effect of the merger between Marathon Ashland Petroleum and Ultramar Diamond Shamrock. In this case, the authors concluded that the merger, and consequently the market concentration, did not create higher market equilibrium prices. These results contrast with those of Chouinard and Perloff (2007) who, by applying a different methodology, noted a positive relationship between the merger processes and gasoline prices.[6]

It should be borne in mind that the DiD is designed to observe if price changes are due to concentration processes. However, we should keep in mind that companies will not change the pricing level after a merger, especially when they operate in perfectly-competitive markets, but also when they are already perfectly colluding. That is why we must be careful in interpreting the results of the Difference-in-Difference estimator when we find no variation in pricing, especially if there are concerns over the degree of competition before the merger.

As an illustration, the analysis of the acquisition of the assets of the multinational petrol company, Shell, in the Spanish Canary Islands, by a local petrol company, DISA, offers a very interesting case to apply the DiD method. On the one hand, the presence of monopoly and oligopoly markets in the Canary Islands allows us to observe the effect of the merger through the differences estimator. On the other, we can also estimate the impact of the merger using a model of conjectural variations.

The econometric results show how the merger process has had no significant effects on pricing. But the empirical results also indicate that a collusive price equilibrium, before and after the concentration process, may explain this result. For this reason, it is easy not to observe price changes when we use the difference estimator methodology in highly concentrated markets, where there may be initial problems of competition. We do not observe any effects on prices because conduct was already near full collusion before the merger.

This paper has the following structure: section 2 details the acquisition process by DISA of Shell in Spain's economic activity. In section 3, we show the data used in this analysis. Section 4 offers the econometric results of the difference estimator, while section 5 analyzes the level of competition before and after the merger process using the structural model. Finally, the last section draws the main conclusions of this paper.

## 2. The acquisition by DISA of Shell's activities in Spain

DISA's acquisition of the assets of Shell in Spain came about when the multinational had to restructure its operations worldwide after financial problems arose in 2004. On January 9th 2004, Shell announced a change in the accounting procedures for its petroleum and gas reserves, which reduced the value of its reserves by a fifth or, by approximately four trillion

[6] Hasting (2004), shows the change of the vertical structure that caused the merger between the vertically-integrated company ARCO and the independent, Thrifty. However, Taylor, Kreisle and Zimmerman (2007), using a different database, found no significant increase in prices.

barrels of oil. The reserves are one of the main factors in the economic valuation of this type of company, and as such, its stock market value was significantly affected.

After the resignation of its president, Philip Watts, and an investigation by America's Securities and Exchange Commission (SEC), the company was fined $120 million by the American regulator and £17 million by the British regulator. These fines were based on the complicity of the company's upper echelons of the deficient accounting of its energy reserves. This was indicated in a letter sent by Walter Van de Vijven, Head of Exploitation and Production, to Philip Watts, the Executive President: 'I am becoming sick and tired about lying' referring to the value of the reserves that the directors knew was overvalued.

This loss of confidence in the company, by investors, brought about an internal restructuring, both of the company's governing bodies, and its activities. Included in this restructure was the sale of the retail businesses in Spain, Portugal, Ireland, Cameroon, Uruguay, and Paraguay.

The sale of Shell's retail gasoline business in the Canary Islands had little or nothing to do with the workings of the local market. This is particularly the case if we bear in mind that the party most interested in acquiring Shell's assets, should be the dominant player in Spain, Repsol–YPF, which effectively acquired Shell's assets in Portugal. However, a regulatory order by the Spanish Government, passed in June 2000, prohibited the acquisition of new gas stations by the dominant players during a five-year period.[7]

All the aforementioned helps us to look upon the acquisition process as an exogenous change, brought about by an event outside the analyzed market. As noted by Dafny (forthcoming), the majority of mergers should be considered as endogenous in nature. Accordingly, this author believes that DiD estimates offer-biased results because the orthogonality condition of natural experiments fails. In the case of DISA's acquisition of Shell assets in Spain, this potential bias is minimized. This is indispensable when studying the concentration process as a natural experiment. As Lafontaine and Slade (2008) point out, the term 'natural experiment' refers to an analysis that fulfills three conditions: an exogenous change in the market; a group of observations affected by the change that we call the treatment group; and finally an unaffected group that we call the control group. The differential response between these two groups, relative to change, is used in order to identify the effects. This has popularized this estimation of casual relationship, which is known as a DiD estimator. Simplicity aside, its great advantage is its potential to avoid many of the problems of endogeneity that habitually arise when carrying out comparisons among heterogeneous individuals (see Bertrand, Duflo and Mullainathan 2004).

The gasoline market in the Canary Islands is ideal for this analysis. The archipelago consists of seven islands, two of which, El Hierro and La Gomera, function under a monopoly run by DISA and were unaffected by the merger. In the other five islands, Fuerteventura, Gran Canaria, La Palma, Lanzarote, and Tenerife, both DISA and Shell were present and the islands were affected by the concentration process; they form our treatment group. Thus,

[7] The Royal Decree 6/2000 was passed on 23 June.

we can isolate the effect of the merger in our treatment group, as we have our control group as a comparison.

A second element of the DISA and Shell operation on which to focus is the strong impact that it had on the market, given that they were the two companies with the highest market shares. In the following table we can see the market shares and the Herfhindal-Hirschman Index (HHI), before and after the merger, in terms of the number of petrol stations on each island.

**Table 1**

Market shares and HHI before and after the merger

| | DISA | Shell | DISA + Shell | Texaco | BP | Repsol | PCAN | Cepsa | HHI (before) | HHI (after) | Change HHI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tenerife | 33 | 16 | 49 | 13 | 17 | 12 | 9 | 0 | 2028 | 3084 | 1056 |
| Gran Canaria | 31 | 18 | 49 | 17 | 23 | 9 | 1 | 1 | 2186 | 3302 | 1116 |
| Lanzarote | 46 | 21 | 67 | 11 | 7 | 8 | 7 | 0 | 2840 | 4772 | 1932 |
| Fuerteventura | 37 | 24 | 61 | 19 | 0 | 10 | 10 | 0 | 2506 | 4282 | 1776 |
| La Palma | 42 | 31 | 73 | 11 | 11 | 5 | 0 | 0 | 2992 | 5596 | 2604 |
| La Gomera | 100 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 10000 | 10000 | 0 |
| El Hierro | 100 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 10000 | 10000 | 0 |

Source: Own elaboration

As we can see in Table 1, the acquisition process increased the HHI from 1056 points in the case of Tenerife to 2604 points for the island of La Palma. We would presume that such a significant increase in the concentration indexes would have some effect on prices. If firms compete in prices or quantities, increasing the concentration leads to higher equilibrium prices, unless there are efficiency gains. However, during the merger process, the companies said that they did not expect to get any efficiency gain. As we will see later, we cannot observe price changes.

## 3. Data

The data we used was produced monthly, broken down island by island, and took place between September 2003 and December 2005. The merger of DISA and Shell was authorized by the Government, after the Spanish antitrust authority recommended that the takeover should be cleared, in December 2004. As Taylor and Hosken (2007) point out, one year should be enough to observe the effects of the merger, when only observing the retail sector's involvement, as we do in this paper. The prices are the monthly averages for unleaded 95-, 97-, and 98-octane gasoline, by island, priced in Euro cents. The total volume sold by retailers in each island and each month is measured in cubic meters. The breakdown of the data for each variety of unleaded gasoline should not affect the analysis, since all the service stations sell the three types of gas; moreover the market shares for the companies are similar for all types of fuel; see Perdiguero and Jiménez, (forthcoming).

The Rotterdam market's refined gasoline rates were taken from the annual statistics of the Organization of Petroleum Exporting Countries' (OPEC), and are the average spot price

for refined 95-octane gasoline, measured in Euro cents per liter. The population headcounts provided by the Instituto Canario de Estadística (Canary Islands Statistics Institute); they are related to the number of air passengers entering and leaving via the Spanish Airports Authority (AENA), which is monitored to control the important tourist flows between the islands. Transport costs, expressed in Euro cents per liter, were calculated using data published on the National Energy Commission's website. Table 2 shows some descriptive statistics for these variables.

**Table 2**

Descriptive statistics

| Variables | Observations | Average | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Price | 196 | 66.86 | 6.94 | 57.2 | 82.4 |
| Quantity | 196 | 9316.16 | 11546.2 | 221 | 32953.9 |
| Population | 196 | 276455.7 | 339473.3 | 10071 | 838877 |
| Tourists | 196 | 187882.6 | 181902.3 | 843 | 579963 |
| New registered cars | 196 | 1165.5 | 1432.8 | 14 | 5492 |
| Gasoline Spot Price | 196 | 32.51 | 7.89 | 21.09 | 51.77 |
| Transport Cost | 196 | 1.89 | 0.39 | 1.27 | 2.25 |

Source: Own elaboration.

## 4. The effects of the merger upon prices using the difference estimator

As we commented previously, the DiD estimator analyzes the impact that a natural experiment has upon a treatment group, compared to a control group that is unaffected by the change. In our case, the three conditions for natural experiments defined by Lafontaine and Slade (2008) have been fully met. In reality, the merger was not an endogenous concentration process that affected the behavior of both the market players. As explained in Section 2, it was brought about by Shell's exit from Spain and by the private negotiations to sell its assets in the archipelago.

Secondly, we have a treatment group, consisting of the five oligopolistic islands, where the merger has affected the market concentrations and market shares. Thirdly, the islands, La Gomera and El Hierro, with a DISA monopoly, constitute the control group as their concentration has not been affected.

We should indicate that, like Hastings (2004), we found no significant change in the market apart from the merger process itself. There were no new competitors, no new services, or products; not even the service stations' emblem was changed, because, up until 2009, they continued to use the name Shell.

The fulfillment of these conditions gives our paper another advantage, as the economic framework is identical for the treatment and control groups: i.e., they are contemporaries; taxes were the same before and after the merger, they were affected by similar patterns of behavior, etc. Other papers had to compare similar markets where a merger didn't take place. Among others, these include: substitutive products in Barton and Sherman's (1984)

study; similar routes in the case of Kim and Singal (1993); other states or regions in the papers by Simpson and Taylor (2008) and Taylor and Hosken (2007).

To implement the DiD estimator, we specify the following linear price: equation[8]

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \\ + \beta_4 D\_structurechange + \beta_5 Dif-in-dif + \beta_6 D\_Oligopoly + \sum_{h=1}^{11} \beta_h Month_h + \varepsilon_{ts} \quad (1)$$

Where $D\_structurechange$ is a dummy variable that takes the value of 1, if the observation was made after the merger and 0 if it took place before the merger. The variable $D\_Oligopoly$ takes the value of 1 for the islands in oligopoly, and 0 for those operating under a monopoly. Finally, the variable $Dif-in-dif$ is the product of these two structural change dummies. This variable takes a value of 1 for those observations that correspond to the island in oligopoly after the merger.

Thus, the estimator is defined as the difference in the average result in the treatment group before and after the change, less the difference in the average result in the control group before and after the merger.

To improve the results, and especially the previous estimator, in general terms, for all the oligopolistic islands, we have studied the possibility that the merger increased the prices differently depending on the island. As we shall see, to control this effect we estimate that the price equation includes the product variable of the island dummy and structural change

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 D\_structurechange + \\ + \sum_{i=1}^{5} \beta_i D\_structurechange * OligopolyIsland_i + \sum_{h=1}^{11} \beta_h Month_h + \varepsilon_{ts} \quad (2)$$

Table 3 brings together the estimates for the DiD model, described in equation (1), with an ordinary least squares and a two-stage least squares estimation that takes care of the endogeneity of total quantity ($Q$) using population headcounts, car registrations and tourist arrivals as instruments. The statistician Hansen shows us that these instruments are not correlated with the error term and thus shows that the instruments are valid.[9]

The joint estimation of the model is correct, and shows a goodness of fit between 0.79 and 0.96. All the significative variables shown are at 1%, except for the oligopoly dummy and its corresponding DiD estimator, although the period's fixed effects have been excluded from the table. Although the sign is what we expected, the non-significance of the oligopoly dummy may be showing us that the prices in the oligopolistic islands, and under

[8] Section 5 includes a more detailed explanation of the terminology of the variables used in the analysis.

[9] Results from pricing equations without $Q$ as explanatory variables offer similar results.

a monopoly, are not considerably different, although the dummy turns significant at the 15% level.

Equally, the difference estimator is not significant.[10] It indicates that the concentration process between DISA and Shell has not affected the prices on the oligopolistic islands, when compared to the monopolistic ones, and shows the aforementioned estimator's lack of significance.[11]

The dummy, which gathers the effect that the structural change has had on average gasoline prices in the Canaries, indicates that the prices have increased in all the islands after the merger; however, this is not due to the concentration process but to a series of exogenous factors not included in the model.

**Table 3**

Two-least squares and ordinary-least squares estimations for all oligopolies islands

| $P_{ts}$ | **2LS** | **2LS** | **OLS** | **OLS** |
|---|---|---|---|---|
| Intercept | 39.2174** | 66.0830** | 42.0299** | 66.0724** |
| | (1.4673) | (0.5760) | (1.1015) | (0.6006) |
| Dummy Oligopoly | -1.9869 | 0.8558 | 1.1439 | 0.6629 |
| | (1.3273) | (0.7897) | (0.7363) | (0.7660) |
| Dummy Merger (Structural change) | 2.4129** | 11.016** | 2.4044** | 11.016** |
| | (0.4185) | (0.8382) | (0.4439) | (0.8724) |
| DiD estimator (oligopolistic islands) | -0.1897 | -0.1810 | -0.1783 | -0.1783 |
| | (0.4134) | (0.9918) | (0.4372) | (1.0329) |
| $Q_{ts}$ | -0.0001** | -0.00002 | | |
| | (0.00002) | (0.00002) | | |
| Transport Cost | 0.7071$^{+}$ | | -0.0981 | |
| | (0.3237) | | (0.1409) | |
| Spot Rotterdam Price | 0.7197** | | 0.7203** | |
| | (0.0241) | | (0.0259) | |
| Centered $R^2$ | 0.9638 | 0.7871 | 0.9619 | 0.7863 |
| F-Statistic | 473.36** | 112.52** | 364.05** | 116.60** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Hansen J Statistic | 0.459 | 2.891 | | |
| | (0.7948) | (0.2357) | | |

$^{+}$ p<.10.

* p<.05.

** p<.01.

[10] In fact, the report provided for the companies by the Tribunal (Expedient C86-04, footnote 105) affirms that (...) an increase in prices of less than 0.15% could be expected because of the concentration.

[11] Bertrand, Duflo and Mullainathan (2004) show the results signifying that the DiD estimator may have a bias that leads to reject the null hypothesis of no effect when the error term is autocorrelated. While our results could suffer from this bias, this would strengthen our result that the merger has not generated any significant effect on prices, even if autocorrelation might lead us to find such an effect incorrectly.

As previously explained, we repeated the analysis for each island, while taking into account the changes in average prices due to the merger. This information is gathered in equation (2), through the estimated parameters $\beta_i$.

The corresponding estimations are included in Table 4, and have been carried out by using the same methodologies as in the previous estimation. As before, the joint significance of the model is correct as the goodness of fit is high between 0.79 and 0.96, and all the estimated variables are significant at 1% or 5%, except those corresponding to the DiD estimator for the islands. Again the instruments used don't seem to be correlated to the error term, which is just what the Hansen Statistic shows.

The conclusion is the same. The merger does not increase the prices on the islands in oligopoly, even in a detailed study at island level, but the prices increase for the whole post-merger period in all the islands. Borenstein (1990) found that prices increase equally for all air routes, not just those affected by the merger. The author believes that one explanation could be the greater facility to collude. However, it is suggested that this is not the case in this research. Nothing suggests that the merger would facilitate collusion, since it does not increase multimarket contact or cross-ownership.

In this research, the vertical disintegration required by the Spanish Competition Authority to accept the merger, may cause the price increase. Before the merger, the company DISA had a vertical integration agreement with the refinery in Tenerife, owned by Cepsa (another company). The fact that DISA petrol stations became vertically disintegrated may explain this increase in prices in all markets, both as an oligopoly or monopoly, after the merger. There is wide empirical evidence that shows how vertical disintegration generates price increases on the market due to a double-marginalization process (Barron and Umbeck (1984), Shepard (1993), Blass and Carlton (1999), Vita (2000) or Bello and Cavero (2008)). If there is no strong competition in both segments of the industry, the disintegration process may lead to a higher equilibrium prices. Although vertical disintegration could be one explanation for the general price increase, it is not the aim of this paper to analyze the effect of vertical relationships in the gasoline market.

**Table 4**

Two-least squares and ordinary least-squares estimations by individual oligopolies islands

| $P_{ts}$ | **2LS** | **2LS** | **OLS** | **OLS** |
|---|---|---|---|---|
| Intercept | 39.3390** | 66.0839** | 42.1719** | 66.0724** |
| | (1.5834) | (0.5746) | (1.1455) | (0.6051) |
| Dummy Oligopoly | -1.8210 | 0.8720 | 1.3388 | 0.6629 |
| | (1.5248) | (0.8441) | (0.8422) | (0.7746) |
| Dummy Merger (Structural change) | 2.4129** | 11.0163** | 2.4044** | 11.016** |
| | (0.4182) | (0.8382) | (0.4478) | (0.8821) |
| DiD Gran Canaria | 0.0181 | 0.0769 | 0.0159 | -0.1033 |
| | (0.5876) | (1.2715) | (0.6236) | (1.2848) |
| DiD Tenerife | -0.2632 | -0.3819 | -0.5205 | -0.6640 |
| | (0.6019) | (1.3391) | (0.6352) | (1.2806) |
| DiD Fuerteventura | -0.3955 | -0.1098 | 0.0152 | 0.0542 |
| | (0.6219) | (1.2494) | (0.6304) | (1.2704) |
| DiD La Palma | -0.3317 | -0.7204 | -0.7284 | -0.5437 |
| | (0.6241) | (1.2532) | (0.6450) | (1.2674) |
| DiD Lanzarote | 0.0241 | 0.2291 | 0.3263 | 0.3653 |
| | (0.6089) | (1.2399) | (0.6309) | (1.2741) |
| $Q_{ts}$ | -0.00006* | -0.00002 | | |
| | (0.00003) | (0.00003) | | |
| Transport Cost | 0.6730$^{+}$ | | -0.1378 | |
| | (0.3724) | | (0.1629) | |
| Spot Rotterdam Price | 0.7197** | | 0.7203** | |
| | (0.0240) | | (0.0260) | |
| Centered $R^2$ | 0.9640 | 0.7879 | 0.9628 | 0.7872 |
| F-Statistic | 401.78** | 90.47** | 338.98** | 93.44** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Hansen J Statistic | 0.495 | 2.216 | | |
| | (0.7806) | (0.3454) | | |

$^{+}$ p<.10.

* p<.05.

** p<.01.

The DiD estimator indicates that the merger has not affected the average final prices of gasoline in the Canaries. Prices have increased in all the islands, but due to causes unrelated to the merger. Consequently, and in accordance with this estimator, the Spanish Competition Authority's decision to accept the concentration was correct. This result may seem surprising since it does not fit with the results of the classical theoretical models. This was a merger that greatly elevated the concentration and where companies did not reap efficiency gains, so the equilibrium price should have increased. However, there is a logical explanation; if, before the concentration process, the companies had reached a price agreement that approached perfect collusion, then the merger process would not increase prices that were already at the joint maximization level of profits. If the price increase

observed in all the islands was caused by double marginalization, it would cause this to occur.

In the next section we analyze the level of competition in the Canary Islands' gasoline market, using a conjectural variations model for the pre- and post-merger period.

## 5. Analysis of the level of competition using a conjectural variations model

This second analysis of the DISA-Shell merger is based on the assumption that the consumer surplus depends on the prices of all the companies operating in the market. We use oligopolistic models that can predict the competitors' reaction, see Weinberg (2008). Despite criticisms raised by Corts (1999), conjectural variation models have been used on numerous occasions to estimate the competitive behavior of the market. Specifically, Coloma (2002) used this methodology to analyze the effect of the merger between the oil companies Repsol and Argentina's YPF, and observed less competitive behavior after the merger; this might explain the higher equilibrium prices.

The theoretical development of the conjectural variation model follows the references by Parker and Röller (1997) and Fageda (2006). More recently the paper by Perdiguero and Jiménez (forthcoming) gives a detailed description of the methodology employed. As in the aforementioned study, we analyze homogeneous good gasoline, by assuming that the consumers choose among the different brands available rather than the different service stations.

Moreover, the Canary Islands' market has certain peculiarities that make the bias, obtained by this assumption, less restrictive. We know that: i) the different companies offer similar services; ii) the locations of the companies on highways (which are scarce in the Canaries) and in urban and inter-urban areas, are very similar; iii) except for those islands with monopolies, only one of the islands' eighty-eight municipalities has a single company; and finally iv) during the last decade, the representation of the brands has remained stable. Given the aforementioned, the pre- and post-merger competition analysis will be carried out using average terms for the island markets.

The generic conjectural variation model has the following characteristics. Let us assume that companies face the following demand function.[12]

$$p_{ts} = f\left(\sum_{i=1}^{N_S} q_{its}, Z_{ts}\right) \tag{3}$$

That is to say that the average price that the companies fix in the moment *t* in the market *s,* in our case each island is a market. $P_{ts}$ depends on the summation of the quantity sold by

[12] The development of the structural model has been fully summarized in the paper by Perdiguero and Jiménez (forthcoming).

each company *(i=1,…N$_s$)* in the moment *t* in the island *s* $\left(\sum_{i=1}^{N_S} q_{its}\right)$, as well as a series of known exogenous factors and grouped into $Z_{ts}$.

The cost function of each of the companies is expressed by the following:

$$C_{its} = F_{its} + C^{vc}\left(q_{its}, \varpi_{its}\right) \tag{4}$$

The symbols represent the following: the total company costs *i* in the moment *t* and in the market *s*, the sum of a fixed cost $\left(F_{its}\right)$, and a variable cost $\left(C^{vc}\right)$. These variable costs depend on the quantity the company has sold $\left(q_{its}\right)$ and on a series of exogenous and known factors by $\left(\varpi_{its}\right)$.

In this way, the function that maximizes each company is equal to:

$$Max_{q_{its}} \Pi_{its} = p_{ts}\left(\sum_{i=1}^{N_S} q_{its}, Z_{ts}\right) q_{its} - F_{its} - C^{vc}\left(q_{its}, \varpi_{its}\right), \tag{5}$$

Where the first order equilibrium condition depends on the following expression:

$$\lambda \frac{\partial p_{ts}(.)}{\partial Q_{ts}} q_{its} + p_{ts}(.) - CM_{its}(.) = 0 \tag{6}$$

The symbols represent the following: $Q_{ts}$ the total quantity sold in the moment *t* and in the island *s*, and $MC_{its}(.)$ is the marginal cost of each company during a determined period and determined island. That is to say:

$$MC_{its} = \frac{\partial C^{vc}}{\partial q_{its}}$$

The parameter $\lambda_{ts}$ is determined by the variation in the quantity offered by the other companies $\left(j \neq i\right)$, when company *i* varies its own supply, which is normally referred to in the literature as conjectural variation. Depending on the variation, we will achieve the perfect competition model $\left(\lambda_{ts} = 0\right)$, Cournot's $\left(\lambda_{ts} = 1\right)$ or a monopoly $\left(\lambda_{ts} = N_s\right)$.

The relative assumption that the companies are totally symmetrical and equal in their strategic behavior in each island, or market, implies equality in the conjectural variation parameter for all of them. From here, by breaking down all the companies, island by island, and assuming equality in marginal costs, we arrive at the following expression:

$$\theta \frac{\partial p_{ts}(.)}{\partial Q_{ts}} Q_{ts} + p_{ts}(.) - MC_{ts}(.) = 0, \quad \forall i \tag{7}$$

Where $\theta_{ts} = \frac{\lambda_{ts}}{N_s}$ measures the average conduct parameter. The parameter ranges between 0 and 1, and its significance is the following: $\theta_{ts} = 0$ is perfect competition; $\theta_{ts} = \frac{1}{N_s}$ is Cournot style competitive behavior, and $\theta_{ts} = 1$ is perfect collusion.

To implement empirically the theoretical model described above, and bearing in mind the symmetry between the companies island by island, we use the following non-linear demand function:

$$\log Q_{ts} = \alpha_0 + \alpha_1 p_{ts} + \alpha_2 Pop_{ts} + \alpha_3 Tourists_{ts} + \\ + \alpha_4 \,\mathrm{Re}\, gister_{ts} + \sum_{h=1}^{11} \alpha_h Month_h + \sum_{s=1}^{6} \alpha_S Island_S + \varepsilon_{ts} \tag{8}$$

Where $\log Q_{ts}$ is the logarithm of the total quantity sold by the companies on island *s* in the moment *t* and depends on the average price that has been fixed ($p_{ts}$); the variable $Pop_{ts}$ measures the number of inhabitants in each island in a year; the number of air passenger arrivals is $Turists_{ts}$; and the number of cars registered is $\mathrm{Re}\, gister_{ts}$. Also, we have introduced dummy variables, by island and by month, which allow us to explain each island's peculiarities in consumption, as well as the seasonality of that consumption.

If we transfer the previous demand function to the equilibrium of model equation (7), we can simplify the latter to:

$$\frac{\theta_{ts}}{\alpha_1} + p_{ts}(.) - MC_{ts} + \upsilon_{ts} = 0 \tag{9}$$

Where $MC_{ts}$ is explained by the following equation:

$$MC_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \sum_{h=1}^{11} \beta_h Month_h + \omega_{ts} \tag{10}$$

Where the marginal cost of the companies, situated in the island *s* at the moment *t* $(MC_{ts})$, depends on: the quantity sold on the island *s,* in the moment *t*; on the rate for refined 95 octane gasoline on the Rotterdam spot market during the month ($GasolineSpot_t$); on the transport cost for each of the islands ($TransportCost_{ts}$); and on a seasonal trend that groups possible increases or decreases of the other different factors in marginal costs. Finally, we include a dummy monthly variable that groups the seasonal differences of marginal costs.

If we introduce marginal cost into equation (9), we obtain:

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \sum_{h=1}^{11} \beta_h Month_h - \frac{\theta_{ts}}{\alpha_1} + \xi_{ts}$$

(11)

If we assume that the conduct parameter of the two islands in monopoly is equal to 1, in the period prior to the merger ($\theta^{M}_{before}$=1), the previous equation can be rewritten in the following way:

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \\ + \sum_{h=1}^{11} \beta_h Month_h - \frac{D^M_{before}}{\alpha_1} - \frac{D^M_{after}\theta^M_{after}}{\alpha_1} - \frac{D^O_{before}\theta^O_{before}}{\alpha_1} - \frac{D^O_{after}\theta^O_{after}}{\alpha_1} + \xi_{ts} \quad (12)$$

Where $D^M_{before}$, $D^M_{after}$, $D^O_{before}$ and $D^O_{after}$ are dummy variables that take the value of 1 for the islands with monopolies and with oligopolies before and after the merger. The constant terms of the islands with monopolies and with oligopolies are determined by the following expressions:

$$co^M_{before} = \beta_0 - \frac{1}{\alpha_1} \qquad co^M_{after} = \beta_0 - \frac{\theta^M_{after}}{\alpha_1}$$

$$co^O_{before} = \beta_0 - \frac{\theta^O_{before}}{\alpha_1} \qquad co^O_{after} = \beta_0 - \frac{\theta^O_{after}}{\alpha_1}$$

In order to identify adequately the constant term, as indicated by Fageda (2006), we must add and subtract the terms $\frac{D^M_{after}}{\alpha_1}$, $\frac{D^O_{before}}{\alpha_1}$ and $\frac{D^O_{after}}{\alpha_1}$ from the price equation, which leaves us with the following:

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \sum_{h=1}^{11} \beta_h Month_h - \\ - \frac{D^M_{before}}{\alpha_1} - \frac{D^M_{after}\theta^M_{after}}{\alpha_1} - \frac{D^O_{before}\theta^O_{before}}{\alpha_1} - \frac{D^O_{after}\theta^O_{after}}{\alpha_1} + \\ + \frac{D^M_{after}}{\alpha_1} - \frac{D^M_{after}}{\alpha_1} + \frac{D^O_{before}}{\alpha_1} - \frac{D^O_{before}}{\alpha_1} + \frac{D^O_{after}}{\alpha_1} - \frac{D^O_{after}}{\alpha_1} + \xi_{ts}$$

(13)

As such, the price equation can be reformulated as follows:

$$p_{ts} = co + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \\ + \sum_{h=1}^{11} \beta_h Month_h + D_{after}^{M} \gamma_1 + D_{before}^{O} \gamma_2 + D_{after}^{O} \gamma_3 + \xi_{ts} \quad (14)$$

Where

$$\gamma_1 = \frac{1 - \theta_{after}^{M}}{\alpha_1} \qquad \gamma_2 = \frac{1 - \theta_{before}^{O}}{\alpha_1} \qquad \gamma_3 = \frac{1 - \theta_{after}^{O}}{\alpha_1}$$

and

$$co = \beta_0 - \frac{1}{\alpha_1}$$

With this specification, we can estimate the conduct parameters, both for the islands with monopolies after the merger process ($\theta_{after}^{M}$), and for the parameters of the islands with oligopolies before and after the merger ($\theta_{before}^{O}$ and $\theta_{after}^{O}$). They are provided by the following expressions:

$$\theta_{after}^{M} = 1 - (\gamma_1 \alpha_1)$$

$$\theta_{before}^{O} = 1 - (\gamma_2 \alpha_1)$$

$$\theta_{after}^{O} = 1 - (\gamma_3 \alpha_1)$$

On the one hand, the result obtained from these parameters measures whether the two island monopolies effectively behave as such in the period after the merger. On the other hand, the parameters of the islands with an oligopoly show behavioral differences before and after the merger process, when compared to the islands with monopolies. They also show if there was any behavioral change, due to the merger process, in the islands with oligopoly.

In Table 5, there is the estimation of the simultaneous equations (8) and (14) using non-linear, three-stage least squares. As can be seen, almost all the variables included are significant, at least at 5%, and include the dummies needed to obtain the parameter before and after the merger process for the islands with an oligopoly. The dummy variable, which indicates the post-merger parameter in the islands with monopolies, is not significant. This indicates there is no significant difference in the behavior of the islands under monopoly conditions, both before and after the merger.

As for the demand equation, we can observe how the price variable is negative and significant at 1%. It shows an average elasticity of demand equal to -0.46, which is very similar to published empirical evidence; see Dahl and Sterner (1991). Equally we can observe how, both the population and the tourists, positively affect the quantities sold, whereas the number of registrations does not appear to be significant. This is probably due

to the fact that this variable does not include the scrapping of vehicles, which has a strong cyclical element; this effect has already been included in the estimation, in the fixed effects of time.

In the price equation, we can see how the international wholesale price and the transport costs increase the marginal cost, and consequently the market price. We ought to point out that there seem to be small economies of scale within the marginal cost, since the variable of quantity is negative and significant at 1%.

**Table 5**

Non-linear, three-stage least squares estimation

| | Coefficient | Z-Student |
|---|---|---|
| Intercept | 6.315** | 43.95 |
| | (0.144) | (0.000) |
| $P_{ts}$ | -0.007** | -3.56 |
| | (0.002) | (0.000) |
| $Population_{ts}$ | 9.15-e06** | 8.54 |
| | (0.000) | (0.000) |
| $Tourists_{ts}$ | 1.40e-06** | 5.43 |
| | (0.000) | (0.000) |
| New Registered $Cars_{ts}$ | 0.00002 | 0.39 |
| | (0.00004) | (0.697) |
| $R^2$ | | 0.99 |
| $Chi^2$ | | 22392.63** |
| | | (0.0000) |
| Endogenous Variable = $P_{ts}$ | | |
| Intercept | 44.032** | 36.42 |
| | (0.000) | (0.000) |
| $D^M_{After}$ | 0.079 | 0.19 |
| | (0.418) | (0.851) |
| $D^O_{Before}$ | -2.335* | -2.29 |
| | (1.022) | (0.022) |
| $D^O_{After}$ | -2.431* | -2.27 |
| | (1.069) | (0.023) |
| $Q_{ts}$ | -0.00007** | -4.02 |
| | (0.00002) | (0.000) |
| Spot $Rotterdam_t$ | 0.444** | 14.14 |
| | (0.031) | (0.000) |
| Transport $Cost_t$ | 0.796** | 3.25 |
| | (0.245) | (0.001) |
| $Time_t$ | 0.390** | 10.84 |
| | (0.036) | (0.000) |
| $R^2$ | | 0.98 |
| $Chi^2$ | | 8478.05** |
| | | (0.000) |

$^+$ p<.10.

* p<.05.

** p<.01.

By applying the formulae to obtain the different conduct parameters, the results initially point to the behavior of the islands with monopolies not varying throughout the period. We would expect it to be equal to one, which is monopoly equilibrium. It is equally appropriate to point out that the behavior of the islands with oligopoly is close-to-perfect collusion. With a figure of 5%, it is not possible to reject such behavior, neither before nor after merger, but with a value of 0.98 ($\theta^{O}_{before} = \theta^{O}_{after} = 0,98$). Moreover, we cannot statistically reject the idea that both parameters may be equal.

**Table 6**

Conduct parameters before and after the merger

| **Parameters** | **Coefficient** | **Z-Student** |
|---|---|---|
| $\theta^{M}_{after}$ | 1.00 | |
| $\theta^{M}_{after} = 0$ | | 120758.99** (0.000) |
| $\theta^{M}_{after} = 1$ | | 0.04 (0.8509) |
| $\theta^{O}_{before}$ | 0.98 | |
| $\theta^{O}_{before} = 0$ | | 13866.89** (0.000) |
| $\theta^{O}_{before} = 1/6 = 0.16$ | | 9723.66** (0.000) |
| $\theta^{O}_{before} = 1$ | | 3.70$^{+}$ (0.0543) |
| $\theta^{O}_{after}$ | 0.98 | |
| $\theta^{O}_{after} = 0$ | | 12690.85** (0.000) |
| $\theta^{O}_{after} = 1/5 = 0.2$ | | 8896.69** (0.000) |
| $\theta^{O}_{after} = 1$ | | 3.68$^{+}$ (0.0552) |
| $\theta^{O}_{before} = \theta^{O}_{after}$ | | 0.07 (0.7892) |

$^{+}$ p<.10.
* p<.05.
** p<.01.

What are the implications of this result? The estimator DiD, is designed to show changes in prices and not the level of competition in the markets. When we are faced with potentially non-competitive markets, including mergers that produce high concentrations and do not generate efficiency gains, it is logical to not observe price changes. In this case, firms collude before and after the concentration process and thus optimal prices are not altered. Therefore, the Competition Authority's decision to clear a merger in a collusive market is

correct when it is focused only on the unilateral effects of mergers. However, competition authorities should not assess the likely impact on pricing, but the multilateral effects of the merger in sustaining collusion when analyzing mergers in already-collusive markets.

## 6. Conclusions

The economic analysis of mergers is one of the most complex tasks in antitrust. This is because it does not analyze what has occurred in the market, but what *may* occur. Moreover, it must be borne in mind that mergers bring contrary effects for consumers. On the one hand, they may generate improvements in efficiency that can be translated into lower prices. On the other hand, the elimination of a competitor may lead to the exercise of market power (unilateral effects) or even to sustaining collusion more effectively (multilateral effects).

One methodology used to examine the effect of mergers is the implementation of natural experiments, especially by using the DiD estimator. To implement it, we need an exogenous change in the market, a control group that remains unaffected by the change, and a group affected by the change. With this methodology we can see how the change affects the market, bearing in mind that the control group is untouched by this change. The majority of the articles that apply this methodology, in order to analyze the effect on the prices of the concentration processes, have found significant price increases, the exception being the research based on the gasoline market.

The application of this methodology to the retail gasoline market in the Canary Islands shows us that the merger between DISA and Shell has not significantly affected retail prices. This result may seem surprising as they were the two main companies with high market shares. According to the results of the decision of the Spanish Competition Authority, to allow the operation would be correct, since there was no detriment to the consumers.

One reason for this result is the lack of competition in the markets. It means that, after the merger was completed, prices didn't rise as they were already at the joint maximum profit; i.e., it was perfect monopoly equilibrium. To test this possibility, we implemented a conjectural variations model that, due to the characteristics of the gasoline market in the Canary Islands, permitted us to observe empirically the behavioral difference between the islands with monopolies and those with oligopolies; also, it enabled us to study possible behavioral changes in the latter group, after the merger.

The econometric results show that we cannot reject the idea that the average behavior of the companies operating in the oligopolistic markets is monopolistic, either before or after the merger. The retail gasoline prices in the Canary Islands have remained unaffected by the DISA-Shell merger because, prior to the merger, the prices maximized the joint profits and because of this, the new company had no incentive to increase prices.

If we analyze the decision by the Competition Authority only from the standpoint of unilateral effects, the decision to accept the merger is correct. Increasing the concentration did not result in any injury to consumers. However, taking into account the multilateral

effects, it is suggested that the Antitrust Authority should examine, in greater depth, the effects of the disappearance of a competitor to maintain the collusive agreement.

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