Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics

Document de Treball 2012/05 38 pàg
Working Paper 2012/05 38 pag.

"Mergers and difference-in-difference estimator: why firms do not increase prices?"

Juan Luis Jiménez and Jordi Perdiguero

Institut de Recerca en Economia Aplicada | *Research Institute of Applied Economics*

Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics
Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • CONTACT: irea@ub.edu

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Abstract

Difference-in-Difference (DiD) methods are being increasingly used to analyze the impact of mergers on pricing and other market equilibrium outcomes. Using evidence from an exogenous merger between two retail gasoline companies in a specific market in Spain, this paper shows how concentration did not lead to a price increase. In fact, the conjectural variation model concludes that the existence of a collusive agreement before and after the merger accounts for this result, rather than the existence of efficient gains. This result may explain empirical evidence reported in the literature according to which mergers between firms do not have significant effects on prices.

JEL classification: L12, L41, L44.
***Keywords*:** Mergers, Gasoline Market, Difference-in-Difference, Conjectural Variation.

Juan Luis Jiménez, Departamento de Análisis Económico Aplicado. Universidad de Las Palmas de Gran Canaria. Facultad de Economía, Empresa y Turismo. Despacho D. 2-12. Campus de Tafira. 35017. Las Palmas. E-mail: jljimenez@daea.ulpgc.es; tel: +34 928 458 191

Jordi Perdiguero, Departamento de Política Económica. Grup de Recerca en Governs i Mercats (GiM). Institut de Recerca en Economía Aplicada (IREA). Av. Diagonal 690. 08034. Barcelona. E-mail: jordi.perdiguero@ub.edu

Acknowledgements:

Thanks are due to Albert Banal, Joan-Ramón Borrell, Javier Campos, Andrés Gómez-Lobo, Daniel Hosken, Consuelo Pazó and George Symeonidis for their helpful comments. The usual disclaimer applies.

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 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, however, introduce an array of assumptions that may have a vital impact on the outcome of the analysis. As Peters (2006) demonstrates, the results are highly sensitive to assumptions about demand, costs and the market's competitive equilibrium.[1]

Direct before and after comparisons of prices offer 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 mergers has grown in recent years.

The DiD estimator seeks to show the change in the relevant variable (typically price levels) in the treatment group (i.e. the market in which firms merge) and in the control group (i.e. the market in which firms do not merge). The control group should be as similar as possible to the treatment group, both in terms of level of demand and supply shocks. The approximation is highly flexible and easy to implement so its application has become quite common in the economic literature.

Most of the studies using this methodology conclude that prices increase as a result of a merger. Examples of studies reporting significant price hikes include: Barton and Sherman (1984) in the microfilm business; Borenstein (1990) and Kim and Singal (1993) in the North American air travel market; and McCabe (2002) in the publishing of scholarly journals. In the banking sector, Prager and Hannan (1998) and Focarelli and Panetta (2003) found that after a merger, savers were rewarded with lower interest

[1] See Budzinski and Ruhmer (2010) for an in-depth explanation of merger simulation models and their application to competition policy.

rates.[2] Vita and Sacher (2001) noted that even non-profit hospitals increase prices after a process of concentration and Dafny (2009) reported the same outcome with for-profit hospital mergers. By contrast, Connor, Feldman and Dowd (1998) found cost and price reductions after a merger among US hospitals. In rail transport, Karikari, Brown and Nadji (2002) also noted reductions in prices, although this result depended on the type of goods, direction of traffic, and the type of transport. Ashenfelter and Hosken (2008) analyzed the effect of mergers, in terms of prices, on five different industries: female hygiene products, alcoholic drinks, lubricating oil, cereals, and breakfast syrups. All except breakfast syrups showed significant price increases.[3]

Although the aforementioned industries show post-merger price increases, the results for the gasoline industry differ markedly. Taylor and Hosken (2007) analyzed the effect of the Marathon and Ashland petroleum joint venture and reported greater concentration and a significant change in the existing vertical market structure. The authors concluded, though, that the merger had no significant effects on final retail 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.[4] These results contrast with those of Chouinard and Perloff (2007) who, when applying a different methodology, noted a positive relationship between merger processes and gasoline prices.[5]

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[2] Sapienza (2002) reported that the effect on loan contracts depended on the size of the banks involved in the merger deal. If the firms had a sizeable market share, interest rates rose; if they had a smaller market share, interest rates fell.

[3] See Weinberg (2008) for a more detailed discussion of most of the above studies.

[4] Sen and Townley (2010) evaluated the effects of reductions in outlet density on retail prices using Canadian data from 1991-97. A 27% decline in retail outlets led to a 9% increase in retail prices. The authors also considered two mergers in this period but reported mixed, and not highly statistically significant, impacts on prices.

[5] Hastings (2004) reports the change in vertical structure caused by the merger between the vertically-integrated company ARCO and the independent, Thrifty gasoline stations. However, Taylor, Kreisle and Zimmerman (2007), using a different database, found no significant increase in prices.

Despite the widespread application of this estimator to measure the effects of mergers, it is not without its critics. One of the most notable is the paper by Bertrand et al. (2004), in which the authors show how the DiD estimator can present false positives. They apply the DiD estimator to examine the effect of invented changes in the labor market on female wages and show how the estimator reports positive and significant effects in 45 percent of cases, even though there was no real change in the labor market. This result shows the bias introduced in data that are serially correlated, so that the standard errors are inconsistent in OLS regressions.

The second major criticism derives from the possible endogeneity in the change in the market. If the change to be analyzed by the DiD estimator is not exogenous, the estimator will be biased and inconsistent. In the case of mergers it seems clear that the decision is not one that is exogenous to the functioning of companies in the market, and much less so to their pricing decisions. The endogeneity problem is explained and discussed in depth by Dafny (2009).

Finally, we need to take into account the criticisms raised by Simpson and Schmidt (2008-2009). In their paper, the authors show that even though the control group suffers the same demand and supply shocks as those recorded by the affected group, if the two groups incorporated these shocks distinctly, the DiD estimator may be biased because they include this difference in the incorporation of demand or supply shocks.

In this paper we examine a new problem in applying the DiD estimator. In this case, the problem involves the interpretation of the estimator. The DiD estimator when applied to mergers examines whether the level of competition has been reduced and, therefore, whether the level of market prices has increased or, by contrast, whether the level of competition, and therefore prices, remains unaffected. We show how the results of the DiD estimator cannot be used to analyze the level of market competition simply to prove a statistical evolution in prices if we know nothing about the reasons underlying this trend. To determine how the merger might affect the level of competition in the market we have to apply structural models. Recall that the DiD is designed to observe if price changes are due to concentration processes. However, companies will not necessarily change their pricing levels after a merger, especially if operating in perfectly competitive markets or when acting in perfect collusion. For this reason we must be cautious in interpreting the results of the Difference-in-Difference estimator when we find no variation in pricing, especially if there are concerns about the degree of competition before the merger.

This result is particularly important in the gasoline market where the level of competition is often quite far from that of perfect competition (Borenstein and Shepard, 1996; Delpachitra, 2002; and Perdiguero, 2010). If companies are acting in almost perfect collusion, mergers will not result in price increases, which would account for the previous empirical outcomes reported in the literature.

By means of illustration, the acquisition of the assets of the multinational petrol company, Shell, in the Spanish Canary Islands, by a local petrol company, DISA, constitutes a highly interesting case to which 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-in-Difference estimator; on the other, we can also estimate the impact of the merger using a model of conjectural variations.

The econometric results show that the merger has had no significant impact on pricing. But the empirical results indicate that a collusive price equilibrium, both before and after the concentration process, might account for this outcome. For this reason, in highly concentrated markets, where there may be initial problems of competition, price changes might not be seen when employing the DiD estimator. In other words, no effects are observed on prices because the firms' conduct was already near that of perfect collusion before the merger.

This paper is structured as follows: section 2 outlines DISA's acquisition of Shell's Spanish assets. In section 3, we present the data used in this analysis. Section 4 reports 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 (6) draws the paper's main conclusions.

2. DISA's acquisition of Shell's Spain activities

DISA's acquisition of Shell's assets in Spain came about when the multinational had to restructure its worldwide operations following financial problems in 2004. On 9 January that year, Shell announced a change in its accounting procedures, which reduced the value of its petroleum and gas reserves by a fifth or, by approximately four trillion barrels of oil. As its reserves are one of the main elements in the economic valuation of a company of this type, its stock market value was significantly affected.

Following the resignation of company 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 in the deficient accounting of its energy reserves. This was more than apparent in a letter sent by Walter Van de Vijver, Head of Exploration and Production, to Philip Watts, the Executive President: 'I am becoming sick and tired about lying', in a clear reference to the value of the reserves that the directors knew were overvalued.

This loss of confidence in the company by its investors brought about an internal restructuring, both of the company's governing bodies, and its activities. Included in this process 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 becomes even more evident if we bear in mind that the party most interested in acquiring Shell's assets at that time should have been the dominant player in Spain, Repsol–YPF, which had effectively acquired Shell's assets in Portugal. However, a regulatory order issued by the Spanish Government in June 2000 prohibited the acquisition of new gas stations by the dominant players during a five-year period.[6]

The circumstances described above illustrate clearly that the acquisition process can be seen as an exogenous change, brought about by an event outside the analyzed market. As Dafny (2009) notes, the majority of mergers can be considered endogenous

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

in nature and, accordingly, he claims that DiD estimates offer biased results since the orthogonality condition of natural experiments fails. In the case of DISA's acquisition of Shell's assets in Spain, however, this potential bias is minimized, which is an indispensable condition when studying a 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, we can isolate the effect of the merger in our treatment group, as we have a control group for comparison.

A second element arising from the DISA and Shell operation was the impact that it had on the market, given that these two companies had the largest market shares. In the following table we can see these market shares and the Herfindahl-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 (in the case of La Palma). We can assume that such a significant increase in the concentration indexes would have had some effect on prices. If firms compete in prices or quantities, increasing concentration leads to higher equilibrium prices, unless there are efficiency gains. However, during the merger process, the companies stated that they did not expect to obtain any efficiency gains. As we shall see below, no price changes were observed.

3. Data

The data used here were produced monthly, broken down island by island, and covered the period from September 2003 to December 2005. Government authorization for the merger of DISA and Shell was obtained after the Spanish antitrust authority gave its clearance for the takeover in December 2004. According to Taylor and Hosken (2007), a year should be sufficient time to observe the effects of a merger when only observing its impact on the retail sector, as we do in this paper. The prices are the monthly weighted averages for unleaded 95-, 97-, and 98-octane gasoline, by island, priced in Euro cents. The total volume sold each month by retailers on each island is measured in cubic meters. The breakdown of the data for each grade of unleaded gasoline should not affect the analysis, since all the service stations sell the three gas grades; moreover, the market shares for the companies are similar for all types of fuel (see Perdiguero and Jiménez, 2009).

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) are related to the number of air passengers entering and leaving via the Spanish Airports Authority (AENA) installations, which is monitored to control the sizeable tourist flows to 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 the 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 commented previously, the DiD estimator analyzes the impact that a natural experiment has upon a treatment group in comparison to a control group that is unaffected by the change. In our case, the three conditions for natural experiments as defined by Lafontaine and Slade (2008) are fully met. In reality, the merger was not an endogenous concentration process that affected the behavior of both market players. As outlined in Section 2, it was brought about by Shell's exit from Spain and by private negotiations to sell the company's assets in the archipelago.

Secondly, we have a treatment group, consisting of the five oligopolistic islands, where the merger has affected market concentrations and market shares. Thirdly, the islands, La Gomera and El Hierro, on which DISA holds a monopoly, constitute the control group as their concentration has not been affected. The control group must, however, have the same market structure as that of the affected group. In our case the control group is a monopoly, which could modify the shape, for example, of transfer costs. Although this might invalidate our control group, we show that the behavior of both groups is identical, and so our control group is fully valid.

We should point out 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; the service stations did not even change their emblem, because, up until 2009, they continued to use the Shell brand name.

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; their taxes were the same before and after the merger; they were affected by similar patterns of behavior; etc. Other papers have had to make their comparisons with similar markets in which a merger had not taken 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:[7]

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

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 operating under an oligopoly market, 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 under an oligopoly after the merger.

Thus, the estimator can be defined as the difference in the average result in the treatment group before and after the change minus the difference in the average result in the control group before and after the merger.

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

In general terms, to improve our results, and especially those of the previous estimator, for all the oligopolistic islands, we studied the possibility that the merger increased prices differently depending on the island. As we shall see, to control for 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 presents the estimates for the DiD model, described in equation (1), with an ordinary least squares and a two-stage least squares estimation that account for 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, that the instruments are valid. The Kleibergen-Paap rk LM Statistic reject the null hypothesis that the first stage is underidentificated, so our instruments are correct.[8]

The joint estimation of the model is correct, and shows a goodness of fit between 0.79 and 0.96. All the significant variables shown are at 1%, except for the oligopoly dummy and its corresponding DiD estimator, although note that the period's fixed effects have been excluded from the table. Although the sign is as expected, the non-significance of the oligopoly dummy may indicate that the prices on the oligopolistic islands and those on the islands under monopoly are not very different, although the dummy is significant at the 15% level.[9]

Equally, the difference estimator is not significant.[10] This indicates that the DISA – Shell merger has not affected prices on the oligopolistic islands, compared to the price

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[8] Results from the pricing equations without Q as explanatory variables provide similar results.

[9] Problems of multicollinearity are not found between the fixed effects of the month and the spot price of gasoline (the correlation ranges from -0.18 to 0.25) or between the fixed effects of island and transport costs (the correlation ranges from -0.42 to 0.61).

[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.

levels on their monopolistic counterparts, 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 prices increased on all the islands after the merger; however, this was not due to the concentration process but rather to a series of exogenous factors not included in the model.

Table 3: Two-least squares and ordinary-least squares estimates for all oligopolistic islands

P_{ts}	2LS	2LS	OLS	OLS
Intercept	39.2174** (1.4673)	66.0830** (0.5760)	42.0299** (1.1015)	66.0724** (0.6006)
Dummy Oligopoly	-1.9869 (1.3273)	0.8558 (0.7897)	1.1439 (0.7363)	0.6629 (0.7660)
Dummy Merger (Structural change)	2.4129** (0.4185)	11.016** (0.8382)	2.4044** (0.4439)	11.016** (0.8724)
DiD estimator (oligopolistic islands)	-0.1897 (0.4134)	-0.1810 (0.9918)	-0.1783 (0.4372)	-0.1783 (1.0329)
Q_{ts}	-0.0001** (0.00002)	-0.00002 (0.00002)		
Transport Cost	0.7071+ (0.3237)		-0.0981 (0.1409)	
Spot Rotterdam Price	0.7197** (0.0241)		0.7203** (0.0259)	
Centered R^2	0.9638	0.7871	0.9619	0.7863
F-Statistic	473.36** (0.0000)	112.52** (0.0000)	364.05** (0.0000)	116.60** (0.0000)
Kleibergen-Paap rk LM Statistic	96.453*** (0.0000)	116.825*** (0.0000)		
Hansen J Statistic	0.459 (0.7948)	2.891 (0.2357)		

+ p<.10.
* p<.05.
** p<.01.

As mentioned above, 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 β_i.

[11] Bertrand, Duflo and Mullainathan's (2004) results indicate that the DiD estimator may have a bias that leads to the null hypothesis of no effect being rejected when the error term is autocorrelated. While our results may also suffer from this bias, it would strengthen our findings that the merger has not had any significant effect on prices, even though autocorrelation might lead to such an effect being detected incorrectly.

The corresponding estimations are included in Table 4, and were carried out applying 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. Here again the instruments used do not appear to be correlated to the error term, which is precisely what is shown by the Hansen Statistic and Kleibergen-Paap rk LM Statistic.

The conclusion is, therefore, the same. The merger did not increase prices on the islands under oligopoly (not even in a detailed study at the island level), but prices did increase for the whole post-merger period on all the islands. Borenstein (1990) reported that prices increase equally on all air routes, not just those affected by the merger. He believes that one explanation could be the greater facility to collude. However, the suggestion is that this is not the case here as there is nothing to indicate that the merger would have facilitated collusion, since it did not increase multimarket contact or cross-ownership.

Here, the vertical disintegration required by the Spanish Competition Authority in order for the merger to be accepted, may have led to the price increase. Before the merger, DISA had a vertical integration agreement with a refinery in Tenerife, owned by CEPSA (a separate company). The fact that DISA petrol stations became vertically disintegrated may account for this price increase in all markets (oligopolies and monopolies) after the merger. There is considerable empirical evidence of how vertical disintegration generates price increases in the market due to a double-marginalization process (Barron and Umbeck, 1984; Shepard, 1993; Blass and Carlton, 1999; Vita, 2000; and Bello and Cavero, 2008). If there is no strong competition in either segment of the industry, the disintegration process may lead to 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 estimates for individual island oligopolies

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)
Kleibergen-Paap rk LM Statistic	54.523***	66.917***		
	(0.0000)	(0.0000)		
Hansen J Statistic	0.495	2.216		
	(0.7806)	(0.3454)		

+ p<.10.
* p<.05.
** p<.01.

We note that the control group in our DiD estimator, the monopolistic islands, has a completely different market structure to that of the affected group, the islands under oligopoly. According to Simpson and Schmidt (2008-2009), this can mean that supply and demand shocks are incorporated differently in the two groups. In turn, the DiD estimator might not show the effect of the merger correctly as the effect of this difference in transmission is also incorporated within the DiD estimator. In the next section we show why we believe that the choice of monopolistic islands as a control group is appropriate and does not bias our DiD estimator.

To test the validity of our control group we follow the methodology used by Albalate (2008): we estimated the same models incorporating dummy variables for years prior to the merger, differentiated for the islands affected and unaffected by the merger and eliminating the variables of the DiD estimator. The econometric result indicates that both groups followed the same trend before the merger (with a probability of 0.7951 that we cannot reject the hypothesis that the two dummy variables are equal), so the result of the difference-in-difference estimator would reflect the specific effect of the merger and not the previous evolution of both groups.

The DiD estimator indicates that the merger did not affect the average final prices of gasoline in the Canaries. Prices have increased on all the islands, but for reasons unrelated to the merger. This result may seem surprising as it does not fit with the predictions of the classical theoretical models. This was a merger that greatly elevated market concentration and in which companies did not reap any 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 could not increase prices that were already at the joint maximization level of profits. If the price increase observed on all the islands was caused by double marginalization, it would have caused this to occur.

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

5. Analysis of the level of competition using a conjectural variation 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 Spanish and Argentine oil companies Repsol and YPF, respectively, and observed less competitive behavior after the merger, which might explain the higher equilibrium prices.

The theoretical development of the conjectural variation model here is in line with Parker and Röller (1997), Fageda (2006) and Puller (2007). More recently Perdiguero and Jiménez (2009) offer a detailed description of the methodology employed. As in the aforementioned study, we analyze gasoline as a homogeneous good, by assuming that the consumers choose between the different brands available rather than between the different service stations.

Moreover, the Canary Islands' market presents certain characteristics that make the bias obtained by this assumption less restrictive. We know that: i) the various companies operating offer similar services; ii) the locations taken by the companies on highways (which are scarce in the Canaries) and in urban and inter-urban areas are very similar; iii) only in one out of eighty-eight municipalities in oligopolistic islands is served by 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, the average price that the companies fix in moment t in market s (in our case each island is a market). Pts depends on the summation of the quantity sold by each company (i=1,…Ns) in moment t on island s $\left(\sum_{i=1}^{N_S} q_{its}\right)$, as well as a series of known exogenous factors grouped into Z_{ts}.
The cost function of each of the companies is expressed as:

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

where the symbols represent the following: total company costs i in moment t in 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 given by $\left(\varpi_{its}\right)$.

[12] The building of the structural model is fully summarized in Perdiguero and Jiménez (2009).

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

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

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

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

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

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

The parameter λ ts is determined by the variation in the quantity offered by the other companies $(j \neq i)$, 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 perfect competition $(\lambda_{ts} = 0)$, the Cournot model $(\lambda_{ts} = 1)$ or a monopoly $(\lambda_{ts} = N_s)$. The relative assumption that the companies are totally symmetrical and equal in their strategic behavior on each island, or market, implies equality in the conjectural variation parameter for all the firms. Thus, by breaking down all the companies, island by island, and assuming equality in marginal costs, we obtain the following expression:

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

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:

$$\log Q_{ts} = \alpha_0 + \alpha_1 p_{ts} + \alpha_2 Pop_{ts} + \alpha_3 Tourists_{ts} + \\ + \alpha_4 \text{Register}_{ts} + \sum_{h=1}^{11} \alpha_h Month_h + \sum_{s=1}^{6} \alpha_S Island_S + \varepsilon_{ts} \qquad (8)$$

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

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

where MC_{ts} is explained by the following equation:

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

(10)

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

If we introduce marginal costs 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 with a monopoly market is equal to 1, in the period prior to the merger (θ^{M}_{before}=1), the previous equation can be rewritten as follows:

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

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 the constant term adequately, 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:

$$p_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 GasolineSpot_t + \beta_3 TransportCost_{ts} + \beta_4 Time_t + \sum_{h=1}^{11} \beta_h Month_h - \\ - \frac{D^M_{before}}{\alpha_1} - \frac{D^M_{after}\theta^M_{after}}{\alpha_1} - \frac{D^O_{before}\theta^O_{before}}{\alpha_1} - \frac{D^O_{after}\theta^O_{after}}{\alpha_1} + \\ + \frac{D^M_{after}}{\alpha_1} - \frac{D^M_{after}}{\alpha_1} + \frac{D^O_{before}}{\alpha_1} - \frac{D^O_{before}}{\alpha_1} + \frac{D^O_{after}}{\alpha_1} - \frac{D^O_{after}}{\alpha_1} + \xi_{ts} \quad (13)$$

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

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

where

$$\gamma_1 = \frac{1-\theta^M_{after}}{\alpha_1} \qquad \gamma_2 = \frac{1-\theta^O_{before}}{\alpha_1} \qquad \gamma_3 = \frac{1-\theta^O_{after}}{\alpha_1}$$

and

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

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

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

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

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

The results derived from these parameters indicate whether the two island monopolies effectively behaved as such in the period after the merger. However, the parameters of the island oligopolies reveal behavioral differences before and after the merger process, when compared to those of the islands with monopolies. They also indicate whether there was any behavioral change, due to the merger process, on the islands under oligopoly.[13]

Table 5 shows 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 they include the dummies needed to obtain the parameter before and after the merger process for the islands under oligopoly. The dummy variable, which indicates the post-merger parameter on the islands with monopolies, is not significant. This indicates that 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 population and 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 contains a strong cyclical element; this effect was previously included in the estimation in the fixed effects of time.

[13] We introduced a cluster by island to take into account the fact that the error term could be different on each island. Our results remained constant however.

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. Note that there seem to be small scale economies within the marginal cost, as the variable of quantity is negative and significant at 1%.

Table 5: Non-linear, three-stage least squares estimate

	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.

When applying the formulae to obtain the different conduct parameters, the results initially indicate that the behavior of the island monopolies did not vary throughout the period. We would therefore expect a value equal to one, which is monopoly equilibrium. Likewise, the behavior of the islands oligopolies is close to perfect collusion. With a figure of 5%, it is not possible to reject such behavior, either before or after merger, but with a value of 0.98 ($\theta^{O}_{before} = \theta^{O}_{after} = 0.98$). This result is not surprising. The economic literature has reported evidence of tacit collusion in the gasoline retailing market before; see, for example, Eckert and West's (2005) analysis of the city of Vancouver.

Moreover, we cannot statistically reject the idea that both parameters may be equal. As discussed above, insofar as the behavior of both groups (control and affected) is the same, the monopoly islands represent a suitable control group in the difference-in-difference estimator. Simpson and Schmidt (2008-2009) identified the problems generated by the presence of different market structures in the control and treatment groups, which results in differences in the transmission of demand and supply shocks to the DiD estimator. In our case, although this difference in market structure exists and it might bias the DiD estimator, the fact that the markets behave in a similar fashion means our control group is suitable.[14]

Table 6: Conduct parameters before and after the merger

Parameters		Coefficient	Z-Student
θ^{M}_{after}		1.00	
	$\theta^{M}_{after} = 0$		120758.99** (0.000)
	$\theta^{M}_{after} = 1$		0.04 (0.8509)
θ^{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)
θ^{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.

[14] Corts (1999) shows how the conduct parameter method can underestimate the degree of market power if firms are involved in dynamic efficient collusion. In our case, the conduct parameter is near the monopoly level so if this bias exists it has only a very slight effect on our estimates. Various studies, including Puller (2009), propose different methodologies to solve this bias. Unfortunately they require firm-level data which we do not have access to.

What are the implications of our result? The DiD estimator is designed to show changes in prices, not changes in the level of market competition. When dealing with mergers in potentially non-competitive markets, including those that result in high concentrations and which do not generate efficiency gains, it is logical price changes will not be observed. In this case, firms collude before and after the concentration process and so optimal prices are not altered. Therefore, the Competition Authority's decision to give its approval to a merger in a collusive market is correct if we focus solely on its unilateral effects. However, in collusive markets, the authorities should not assess the likely impact on pricing, but rather the multilateral effects of the merger on sustaining collusion.

This result is especially important for the gasoline retail market since the literature has reported empirical evidence of collusion. Likewise, our result helps explain why the DiD estimator finds positive effects of mergers in prices in all markets except that of gasoline. The difference in the level of competition would seem to account for the difference in behavior.

6. Conclusions

The economic analysis of mergers is one of the most complex tasks in antitrust enforcement since it does not analyze what has occurred in the market, but rather what may occur. Moreover, mergers can have contradictory 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 collusion being more effectively sustained (multilateral effects).

One methodology adopted in examining the effect of mergers is the implementation of natural experiments, especially using the DiD estimator. To implement this, 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 articles that apply this methodology to analyze the effect on prices of concentration processes report significant price increases, the exception being the research conducted to date in 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 had previously been the two leading companies in terms of their respective market shares. Although the unilateral effects of the merger do not increase prices, the elimination of an operator makes it easier to reach the collusive agreements that seem to exist in the market. Therefore, accepting the merger does not seem a good idea; on the contrary, encouraging the entry of more operators to increase competition would appear to be the best option.

One reason for this result is the lack of competition in the markets. This means that, after the merger was completed, prices did not rise as they were already fixed at the joint maximum profit; i.e., perfect monopolistic equilibrium. To test this possibility, we implemented a conjectural variation 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; additionally, it enabled us to study possible behavioral changes in the latter group following 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, prices maximized joint profits and because of this, the new company had no incentive to increase prices.

If we analyze the Competition Authority's decision only from the standpoint of unilateral effects, the decision to accept the merger can be considered correct. Increasing market concentration was not detrimental to consumers. However, if we take multilateral effects into account, it seems that the Antitrust Authority should have examined in greater depth the impact of the disappearance of a competitor on the maintenance of a collusive agreement. This recommendation is essential for the gasoline market because the empirical literature reports evidence of non-competitive behavior in this industry. In fact the non-competitive behavior of this industry might explain why the DiD estimator invariably finds positive effects of mergers on prices except in the gasoline market.

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Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics

Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • **CONTACT:** irea@ub.edu