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Pay cycles and fuel price: a quasi experimental approach

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Abstract

This paper studies the daily price fixing behaviour of the Spanish fuel stations. Using a difference-in-differences approach, we show that low-cost and independent operators take advantage of needier consumers. Their prices increase on the day the unemployed workers receive their subsidy from the government, whereas, on the same day, branded companies decrease their prices. Retailers, aware of this, raise the price when they know demand increases. This phenomenon emphasises the effect of pay cycles on consumer choices and their related economic impact. Findings are also relevant for Antitrust authorities which generally focus on the activities of major brands' stations.

Keywords: retail fuel pricing; subsidy recipients; low-cost stations; pay-cycles.

JEL Classification: D12; H53; L11; L22; L40.

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1. Introduction

Fuel consumption is quite relevant, as it represents a large share of household expenditure and it is an input in most production processes all over the world. In the United States, in the last five years, households spent on fuel between 2,5 and 4% of mean income[1]. In terms of final consumption, in Europe 6,7% of household consumption expenditure is related to fuel and maintenance of personal transport. Italy, France and Spain are above the average with, the first two countries allocating 7,6% of overall family expenditure to this sector and Spain 7,2% (Eurostat, 2017).

In a number of OECD countries, road fuel markets are considered competitive at the retail level, with price levels and volatility reflecting fundamental demand and supply factors and not lack of competition or anticompetitive conduct. However, there is concern that retail road fuel market prices can be distorted even in seemingly competitive markets (OECD, 2013). Historically, the attention of the antitrust authority has focused on the activities of the fuel operators of the major brands[2]. Less expected and, to the best of our knowledge, not yet present in the literature, are strategic or anticompetitive behaviours by the so-called low-cost, supermarket and independent fuel companies. In general, their presence has been considered very beneficial for the market. Documents of the antitrust authorities and research papers in various countries (Gonzalez and Moral, 2019) tend to assume a positive attitude with respect to these operators, emphasising their role in calming pricing dynamics and in serving a weaker segment of the population as opposed to that of major brand stations (with supplier control over price), which tend to match the market mode price (Eckert and West, 2005). Those operators are often defined as price levellers for the more "captive" consumers, i.e. those with lower income[3]. As Chandra and Tappata (2011) show, in fact, consumers could save as much as 5% by price shopping for fuel within 1-mile radius.

If a key question for competition authorities is how to distinguish lawful from unlawful conduct in the absence of direct evidence of an agreement or to identify strategic behaviours among operators at the expenses of consumers, from a consumer point of view, it is important also to understand pricing behaviour of alternative operators in order to make the "right" choice. This

[1] U.S. Energy Information Administration, Short-Term Energy Outlook, and U.S. Census Bureau and Bureau of Labor Statistics.

[2] Several studies often document how big-brand gasoline companies agree with each other to take advantage of consumers and have a dominant position in the market. Among the others see: Clark and Houde, 2013; Eckert, 2013; Perdiguero, 2010, 2012.

[3] According to the OECD (2013), the entrance of supermarkets in the retail road fuel market and the entry of small, independent retailers, has had a significant marked effect on prices.

is the more so, for the "weak" part of the population, i.e. those consumers that might be defined as "needy". The low-income groups, in fact, are less mobile and might be more penalised by increases in prices, as their demand is relatively inelastic (Andreyeva et al., 2010). There is a wide body of literature concerning income and price elasticity of fuel which seems to agree that low-income classes have, in fact, a more rigid demand to both price and income variations. Consumption behaviour, in fact, is different among different classes of consumers. The driving households in the lowest income classes drive for their livelihood and essential mobility and, therefore, their fuel consumption is a bare necessity. Also, there is evidence in the literature, not specifically related to fuel consumption, that changes in disposable income in very short periods influence behaviour of low-income consumers, that, right after receiving their paycheck, increase expenditure considerably, especially on necessities (Berniell, 2018).

In this paper we test the pricing behaviour of pump stations in presence of temporary potential demand shocks caused by a larger availability of disposable income for a specific segment of the population in a specific moment in time. Given the evidence of pay-cycles on consumer behaviour shown in other markets, we investigate whether fuel stations adopt strategic behaviour in price-fixing strategies. We carry out this analysis using Spanish national data. In all of Spain, on the 10th of each month, the "*subsidio desempleo*" (unemployment benefit for Spanish citizens), is paid out to all the citizens that have a right to it. It is a national level policy, uniform in all the areas of the country and, thus, we are able to compare the behaviour of different types of retailers with respect to the same potential demand shocks. We aggregate pumps in four groups according to the type and separate also retailers located on motorways. We obtain five different groups. We analyse the behaviour of all pump stations and check whether different types of stations, with different pricing strategies, act differently in this specific day. In particular, we analyse retailers' behaviour on the day the subsidy is paid out. The econometric analysis is carried out using a difference-in-differences estimation in order to determine whether there is a meaningful difference in prices when the subsidy is paid out. We consider as treated group the different fuel stations located in trunk or urban roads and as control group the fuel stations located on motorways. We find that, between the 10th and the other days of the month, low-cost and independent stations, from whom recipients of subsidies are more likely to buy for their lower prices, take advantage of the situation by increasing prices than other branded companies.

The rest of the paper is organised as follows. In Section 2, we outline the relevant literature and we briefly discuss the Spanish market case highlighting the petrol market characteristics and the unemployment subsidy policy. In Section 3 we present the data. In

Section 4 we explain the empirical approaches used, and in Section 5 we discuss the results. In the last section, we give some conclusions and a future research perspective.

2. Literature and background

2.1 Literature Review

In the fuel market, characterised by physically homogeneous and undifferentiated products, competition is essentially based on pricing and fuel stations' characteristics (location, services at the stations, shops, etc.). Consumers, generally, have an incentive to refuel at stations that minimize their costs. However, search costs and transaction costs, arising from a change of supplier, limit competition in the market and can lead to market prices higher than expected in a competitive environment.[4]

Historically, there is evidence from OECD countries, that an increase in prices has a greater impact on the demand than a price reduction, and that demand is more responsive to an increase in income than to a reduction in income, but this is particularly so for middle-income classes and not for high- and low-income (Gately and Huntington, 2002). Wadud et al., 2009, with reference to the United States, show that there is income and price insensitivity to fuel consumption in the lowest income quintile. Empirical evidence of income effects in purchase decisions is found also in California, USA, where if the gasoline price rises, consumers re-allocate their expenditures across and within food consumption categories, in order to free up income to maintain their gasoline expenditure levels: they offset the increase in fuel spending by reducing other expenses (Gicheva et al., 2008). Similar evidence is found, at European level, on French data. Cayla et al. (2011) looking at household expenditure data find that the poorest consumers do not reduce their fuel expenditure as their income decreases or as prices rise. Also for the richest consumers, when saturation is reached, nothing changes. It is the middle-income class that increases expenditure when their income increases. Overall, at worldwide level, as Havranek and Kokes (2015) demonstrate thought their cross-country meta-analysis, demand

[4] The CNC's follow-up report on the automotive fuel market in July 2012 indicates search costs as a possible explanation for the asymmetries observed in the speed of retail price adjustments. In particular, for the Spanish market, "given the limited presence in the Spanish market of operators with ample opportunity to advertise their prices, as in the case of service stations in large commercial complexes, new installations of this type of operators can help reduce these research costs and consequently increase competition in the retail market, as well as other measures to promote the transparency of retail prices at service stations, such as encouraging the real-time access to service station prices from mobile devices would help reduce these research costs." A recent natural experiment conducted in the gasoline market, focusing on search costs, is the one written by Noel (2018). He establishes that an exogenous shock to price dispersion impacts the amount of consumer search.

for fuel is almost insensitive to changes in income in the short run and relatively insensitive to income in the long run, especially for lower income classes; the same for price changes[5]. Aklilu (2016) estimates the price and income elasticities for gasoline and diesel across 28 EU countries using data from 1978 to 2013. He finds that the diesel price elasticity for Spain in the short term is -0.142 (in line with 23 countries that fall in the range of -0.02 to -0.4)[6]. In Spain, after the 2007 crises, expenditures on gasoline and diesel fell at an average annual rate of 5% and 4.3%, respectively, with contraction of production-linked demand and available income, due to wage reductions and increasing unemployment (Bakhat et al., 2017). Availability of income, thus, seemed to affect consumption in Spain in times of economic crises.

It remains interesting to see whether changes in disposable income in very short periods - i.e. within the month -, influences behaviour of income receiver, especially in the lower income classes, that cannot count on reserves, also outside of crises' periods. An extensive literature, mainly on USA based evidence, states that household expenditure raises immediately after income receipt (Stephens, 2006; Mastrobuoni and Weinberg, 2009), but at the microeconomic level, there is little empirical evidence about the sensitivity of the timing of household purchases to the timing of the reception of the income. As we have anticipated, among the few studies, Berniell (2018)'s asserts that household expenditure increases considerably after income receipt. She exploits two forms of exogenous variation in pay frequency and shows that those who are paid recurrently have flatter expenditure paths. Comparing this group with another one in which salary is paid with a different frequency in time, she finds that "low frequencies lead to a within month business cycle, when many workers are paid in the same dates, which in turn generates costly congestion in sectors with capacity constraints." This shows that frequencies of payment are important because they affect the consumption pattern and have an impact in the market. In fact, "if infrequent payments lead to cycles in the expenditure of some households, this non-smoothing behaviour would translate into the aggregate economy, generating within-month business cycles if many of these consumers are paid at a low frequency and at the same time" (Berniell, 2018; page 2). Stephens (2003, 2006) finds evidence of a purchasing cycle in two different populations: social security recipients in the United States and pay-check recipients in the UK, both of whom receive checks monthly.

[5] To examine cross-country differences in the income elasticity of fuel demand, they include dozens of countries, but, since for most of them only a few estimates are available, they focused on the ones most frequently examined in the literature: Australia, Canada, France, Germany, Japan, Sweden, and the USA.

[6] There is an extensive literature on diesel and gasoline demand elasticity. Among the others see: Espey, 1998; Graham and Glaister, 2002; Ajanovic et al., 2012; Dahl, 2012.

For both groups, he finds that spending on instantaneous consumption (fresh food, food away from home, entertainment) increases following income receipt. Hastings and Washington (2010), using grocery store data for California, show that benefit recipients do relatively more of their food shopping at the beginning of the month (day on which benefits are distributed). Moreover, they find a sharp decrease in benefit households' food expenditures of 20% from the first to the second week of the month and continue to decline less steeply through the remainder of the month. From week one to week four, benefit households reduce their quantities purchased by 32%. There are, thus, evidences of expenditure behavioural patterns due to income availability for lower income classes. None of these studies, however, analyse spending behaviour with respect to fuel demand and, more importantly, no studies verify the reaction of sellers to the behaviour of consumers. In other words, to the best of our knowledge, no analysis has been carried out to determine strategic behaviour of sellers in presence of a within-month business cycle due to income receipt for low-income classes. We think this is particularly relevant especially with reference to a specific type of good, which could be considered homogeneous and widely supplied on the territory.

2.2 The Spanish market cases

Liberalisation of the market, introduced in Spain in 1995, has increased the number of fuel stations by more than 70% (Bernardo, 2018). This significant increase has had an impact also in the composition of operators, with independent and unbranded companies becoming the third most important group after Repsol and Cepsa, already in the years following the reform[7]. The liberalisation of the market, in fact, has benefitted greatly low-cost companies, unbranded petrol stations and supermarket chains and has increased choice for consumers. Major players have been forced to gradually reduce the number of owned fuel stations in order to avoid monopolistic practices. In 2019, the number of active fuel stations in Spain was 11.609 (Statista, 2019), an increase of 1% with respect to last year. Repsol and Cepsa have maintained their advantage with 3,350 and 1,522 petrol stations, respectively. Table n.1 summarises the composition of the markets.

[7] On the immediate impact of the reform on the composition of the retailers see: Bello et al. (2007) and Bello et al. (2008).

Table 1. Market shares of fuel stations in Spain.

Brand	Stations (n)	Percentage (%)
Repsol	3,350	28.86
Cepsa	1,522	13.12
BP	747	6.44
Disa	578	4.98
Galp	570	4.90
Avia	186	1.60
Meroil	152	1.30
Ballenoil	106	0.91
Saras	90	0.78
Others	4.308	37.11
Total	**11609**	**100**

However, the alternative players are about 33% of the country's fuel station network, with 3,941 locations, an increase of 4,5% with respect to the previous years. According to data from the Annual Report of the Spanish Association of Oil Product Operators (AOP, 2019), non-historic oil companies have 2,995 outlets, 5.6% more than the previous year; hypermarkets and supermarkets operate 375 outlets, 2% more; finally, cooperatives run 571, 0.8% more than previous year. Spain is now the fourth for number of stations among European OECD countries.[8] A relevant aspect for our study is the location of pump stations. The largest number of branded gas stations is concentrated in urban centres, main roads and motorways, while independent stations, supermarkets and low-cost stations are mainly localised in the suburbs and in the outskirts of the cities[9]. Given the urbanisation patterns of Spanish cities, these are in the peripherical areas of the territory. Different fuel companies choose to localize according to the target (and personal income) of the final consumers. Buying from low-cost fuel stations means spending less because of the cheaper price but it might cost more in terms of transportation costs: people with high income and high value of time make their purchases at branded stations, in the centre, while unemployed people, with low income, prefer to search for the fuel stations, charging the lowest price, usually in the periphery or near shopping centres and supermarkets where they go for shopping.

[8] The first is Italy with 20.800 pumps, and before Spain there are: Germany (14.459) and Turkey (12.871). As analysed by several researchers such as Correljé (1990) and Perdiguero (2010), the Spanish fuel market is characterized by the presence of big companies that have always dominated the market.

[9] For a detailed analysis of the location of pumps the reader is referred to one of the apps that identify the pumps on the territory. Also, the study of Bello et al. (2008) contains a detailed description.

As we have anticipated, in Spain, workers that have lost their job receive the unemployment benefit or "*subsidio desempleo*". This subsidy is delivered by the central Spanish government and it has exactly the same characteristics throughout the country. The amount of unemployment benefits depends on the salary received by the worker in the last six months. Specifically, unemployed people receive 70% of their salary for the first three months and 50% for the following months. The duration depends on the time the workers were employed in the last 6 years, limited to a maximum period of two years. This subsidy is received on the 10th of each month[10]. If the 10th day of the month corresponds to a Saturday, Sunday or bank holiday, the subsidy is received the next working day (11th or 12th).

3. Data

The data for Spain is readily available and homogeneous at the national level and, thus, represents a unique opportunity to verify our hypothesis. We also have pump-level daily posted prices for all the stations on the national territory, including their brand, type and geographical position, for a two-year period (1st January 2015 to 31st December 2016). These are millions of millions of daily prices observations. We can thus verify whether there are different strategies among different types of pumps' operators, and whether it is always true that low-cost fuel pumps lead to greater benefits for consumers than branded stations in terms of both lower prices and lower exploitation of customers.

We chose diesel prices to be analysed as the dependent variable, given the high percentage of diesel consumption compared to other types of fuel.[11] The reference area covers the entire Spanish territory except the Canary Islands because they have a different organizational set-up and market share of large oil companies.[12] We downloaded data for the different gasoline stations from the Spanish Ministry of Industry, Commerce and Tourism website, which provides daily prices and companies' brand for each service station. We downloaded a database

[10] There were approximately 63002 subjects who received the subsidy in 2015, 93361 in 2018. For details: https://www.cronista.com/economiapolitica/Desempleo-cobran-subsidios-117.000-personas-casi-el-doble-que-en-2015-20190920-0047.html

[11] As noted by Gonzàlez-Marrero et al. (2012), there has been a "dieselisation process" all over Europe which, in Spain, has led to a change the motorization rates by type of fuel in favour of diesel cars (+9,2% as opposed to +2%). Diesel cars accounted for a minor part of the fleet at the beginning of the 1980s and nowadays represent more than 40% of the total EU fleet (Gonzàlez-Marrero et al., 2019).

[12] As observed by Jimenez and Perdiguero (2012), the gasoline market in the Canary Islands, presents relevant and different characteristics. In fact, depending on the islands considered gasoline markets could be a monopoly or an oligopoly.

of approximately 5 million observations. The various fuel distribution plants are identified by the Ministry through geolocation (latitude and longitude).

We split the treated group into 4 categories, following the classification of the *Commisiòn Nacional de Energia*[13] (2012). The first category includes "large companies" such as Repsol, Cepsa and BP and their various subsidiaries; the second category includes "traditional oil companies" such as Shell, Petrocat, Galp; the third category includes "independent stations" (individual, family, non-affiliated companies); the fourth includes "low-cost stations", considering gas stations in supermarket/hypermarket areas (Carrefour, Eroski, etc.) and cooperatives. For the difference in difference approach we built *Motorway* as the control group which considers all the fuel stations located on free motorways and toll motorways. These are different from the previous four groups where only the fuel stations not situated in motorways are considered. The stations operating on motorways represent a valid control group since the pricing strategies adopted are not the same as the service stations located in the cities. The European Commission[14] considers fuel retailing on motorways as a separate product market for different reasons. First, the fuel demand is captive, insofar as drivers rarely leave the motorways to buy fuel from a fuel station located off the motorway. Second, drivers travel on motorways for the possibility to go faster than other urban roads, and so are disinclined or less willing to waste time in refuelling. Furthermore, drivers on motorways typically do not know in detail the local fuel market off the motorway (as they often do not live nor work in the vicinity). And, more importantly, if the drivers have paid a toll that is not designed as linearly related to distance, this outlay serves as a further deterrent to their exiting the motorway in search of low-priced petrol stations on the adjacent roads. All these characteristics make the fuel stations on motorway different from those operating in urban context (Albalate and Perdiguero, 2015).

Dummy10th is a dummy variable that corresponds to the 10th of each month in which unemployed people receive the subsidy. This dummy variable includes the days that correspond to the 10th of each month or to the first available weekday after the 10th of the month since the subsidy is not delivered on the weekends or on bank holidays. It is difficult, generally, to obtain data about consumption that affect pay cycles, because the payment decisions are treated like endogenous variables, but, in this article, the exogenous change depends on the day

[13] For details: https://www.cnmc.es/sites/default/files/1547584_8.pdf

[14] European Commission decisions on 29 September 1999 and 9 February 2000 regarding concentration operations affecting Exxon/Mobile and Total Fina/Elf, respectively.

of subsidy delivery. This exogenous variable is known by fuel stations, since the available money of those who have a lower propensity to purchase on other days of the month increases in this specific day.

To observe the trend of prices over the week and to control for this effect, we built also a group of dummy variables to identify the different days of the week (*Monday* to *Sunday*), which take value 1 if the price corresponds to the specific day of the week, 0 otherwise.

The *Brent* variable approximates marginal cost. It is the price of the crude oil that serves as a major benchmark price for purchases of oil worldwide. This variable is collected from Department of Energy of the US Government.[15]

Furthermore, as a robustness check, we split the fuel stations operating in free and toll motorways. We created the *Did Free Motorway* variable, which reflect the effect of the policy on the stations operating on the free motorway. This variable is given by the interaction among the *dummy10th* variable and the free motorway group. The control group, in this case, is represented by fuel stations located in toll motorways.

The summary statistics are shown in Table 2. The days of the week have different means implying that the dataset is unbalanced. It can happen that companies do not communicate the prices charged at the pump every day – especially at week-ends – or, more rarely, that we have not been able to download data from the Ministry website due to technical problems on the webpage.

[15] U.S. Energy Information Administration (EIA) https://www.eia.gov/petroleum/

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	4,843,162	1.073	0.091	0.743	1.384
Monday	4,843,162	0.157	0.364	0	1
Tuesday	4,843,162	0.152	0.359	0	1
Wednesday	4,843,162	0.144	0.350	0	1
Thursday	4,843,162	0.151	0.358	0	1
Friday	4,843,162	0.146	0.353	0	1
Saturday	4,843,162	0.118	0.323	0	1
Sunday	4,843,162	0.129	0.336	0	1
Brent	4,843,162	0.309	0.055	0.175	0.426
Motorway	4,843,162	0.031	0.175	0	1
Dummygroup1	4,843,162	0.554	0.496	0	1
Dummygroup2	4,843,162	0.123	0.329	0	1
Dummygroup3	4.843.162	0.233	0.423	0	1
Dummygroup4	4,843,162	0.055	0.229	0	1
Dummy10th	4,843,162	0.034	0.182	0	1
Free motorway	4,843,162	0.022	0.146	0	1

4. Empirical Strategy

In Table 3 we observe that, on average, the *Price* variable is smaller the 10th day (1.066), while on the other days it has a larger value (1.072). The t-test shows that the average prices are significantly different from each other and that these differences are significantly different from zero.

Our data reflects market data quite well as the market share of "branded stations" holds 57% of the total, while low-cost companies 6%. These values are shown in Table 4.

Table 3. Average Price

Average price	Mean	Std. Dev.	Min	Max
On the 10th day	1.066	0.091	0.760	1.384
On the other days	1.072	0.092	0.743	1.384

Table 4. Market share of fuel companies in Spain

Group	Share
Group 1 (large companies)	0.57
Group 2 (traditional oil companies)	0.12
Group 3 (independent stations)	0.24
Group 4 (low-cost stations)	0.06

For our empirical analysis we use a panel fixed effect model. Since OLS assumptions are commonly violated in a data panel, there are serious risks about contemporaneous correlation and serial correlation. To diagnose the autocorrelation issue, we use the *Wooldridge test*. We reject the null hypothesis and assert that there is an autocorrelation problem, and so the errors are not independent. In the estimation we solve this problem for the two approaches.

The first approach considers three different models and includes the following variables:

$$P_{it} = \beta_0 + \beta_1 Dummy10^{th} + \beta_2 Tuesday + \beta_3 Wednesday + \beta_4 Thurday + \beta_5 Friday + \beta_6 Sunday + \beta_7 Brent_{t-1} + \varepsilon_{it} \quad [1]$$

Where:

- P_{it}: is the diesel price;
- *Dummy10th*: is a dummy variable equal to 1 for the 10th day of the months where unemployed people receive their subsidy and 0 otherwise, for all the petrol stations;
- *Tuesday* to *Sunday*: are dummy variables that identify the different days of the week;
- *Brent*: is the price of the Brent oil per litre in *t-1*.

In the three models we use regression [1], in the following way:

1) In the first model, we analyse the sign and the numerical value of the price on the 10th of each month (*Dummy10th*) for all the fuel stations located in mainland Spain. With this analysis, we investigate the different weights of the days of the week in the price-formation process.
2) In the second model, we consider the same effect on the 10th of each month for fuel stations located in the national territory, excluding those that operate on motorways.
3) In the third model, we consider only fuel stations that operate on motorways.

We expect to find significant and negative values of *Dummy10th* in the first and in the second model, while in the third one, we expect to find a non-significant value. If this occurs, it is possible to use this group as the control group in the difference-in-differences model.

In the second approach (4th model) we apply the difference-in-differences estimation. Using this approach, we analyse the impact that a natural experiment has on a treatment group (the sum of the four different groups not located on motorways) in comparison to a control group, and we observe whether the impact is unaffected by the change. As seen by Lafontaine and Slade (2008), we have a natural experiment when three conditions are realised: the presence of an exogenous change in the market (*Dummy10th*), a group treated by the exogenous change (sum of the four *Dummygroup* variables*)*, and one unaffected group, the control group (stations located on motorways). All of these conditions hold for our analysis.

In particular, we use the following specification [2]:

$$P_{it} = \beta_0 + \beta_1 Didgroup1 + \beta_2 Didgroup2 + \beta_3 Didgroup3 + \beta_4 Didgroup4. \qquad [2]$$
$$+ \beta_5 Tuesday + \beta_6 Wednesday + \beta_7 Thurday + \beta_8 Friday + \beta_9 Sunday$$
$$+ \beta_{10} Brent_{t-1} + \varepsilon_{it}$$

Where:

- P_{it}*:* is the diesel price;
- *Didgroup1, Didgroup2, Didgroup3, Didgroup4*: represent the interactions between *Dummy10th* and each *Dummygroup* variable. The *Dummygroup* are dummy variables equal to 1 if the petrol station is related to groups 1, 2, 3 or 4 and are not located on motorways.
- *Tuesday* to *Sunday*: are dummy variables that identify the different days of the week;
- *Brent*: is the price of the brent oil per litre in t-1.

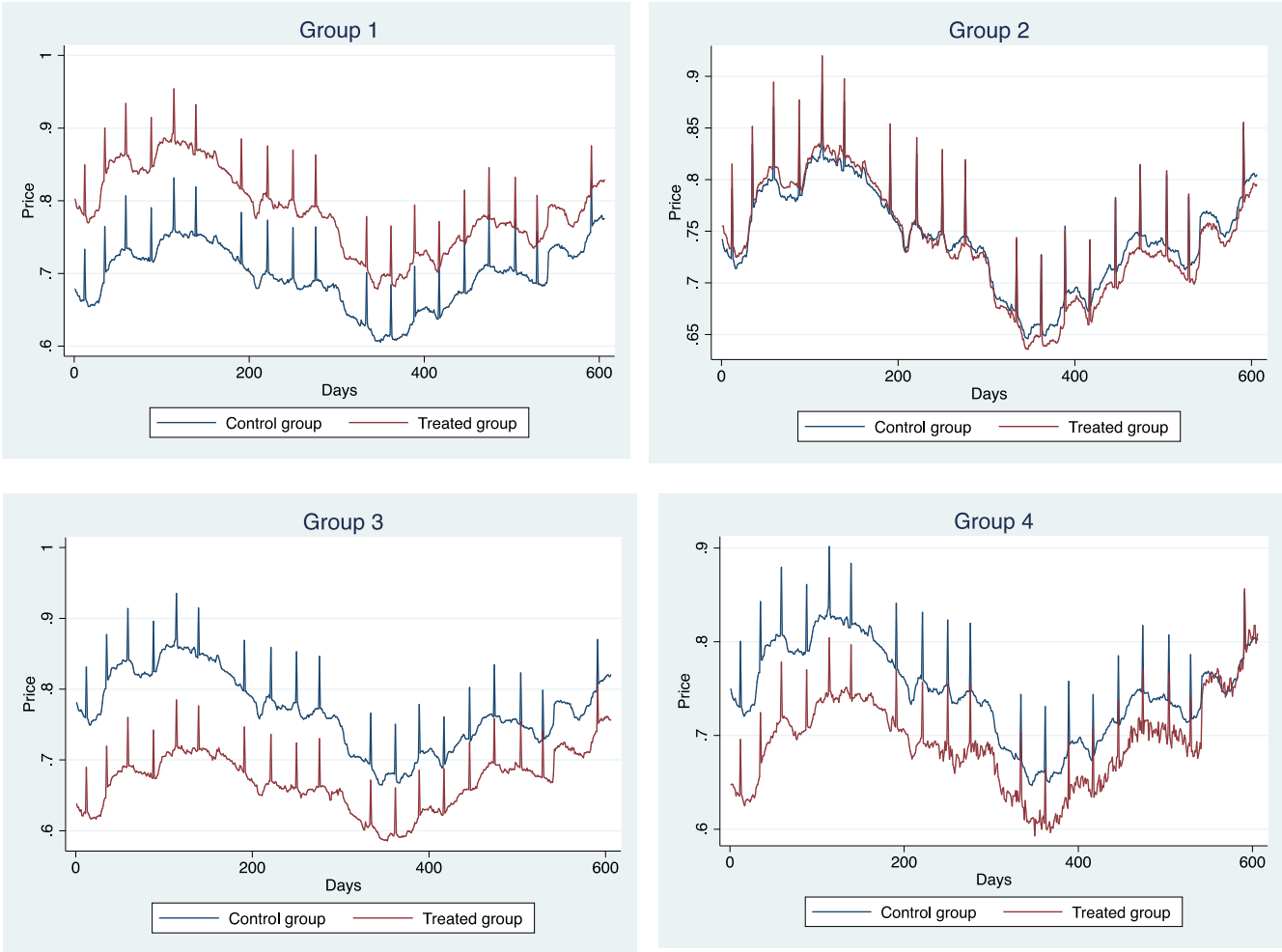
In this model we consider fuel stations that are not located on a motorway.

This approach is useful to show the price variation in the control group (companies located on motorway) and in the treated group. The control group must be as similar as possible to the treatment group in terms of demand and supply shocks.

In this study, these conditions are fully respected. The strength of this method is the high flexibility and the easy implementation of variables in the estimates. A test for the common trend assumption is needed to reinforce the argument for the use of the difference-in-difference

approach. To this end, figure 1 provides a graphical representation of the common trend characterizing the treatment and the control group, for each group considered in the analysis. A change in the price-trend occurs in correspondence of the 10th of the month for the two years, differently, in the other days, the common trend is respected.

Figure 1. Common Trend Analysis



5. Results

At the beginning of this analysis, we consider the average prices between groups the 10th of each month and in the other days (Table n.5). The major stations' group (first group) has an average price that is greater than the others. The price difference between the largest branded retailer and the low-cost operators is, on average, 0,084 euro. Despite the fact that the product is not perfectly homogenous among fuel stations, for different locations, brands, quantities and

qualities offered, this gap could explain why unemployed people prefer to refuel at low-cost. This difference in price is confirmed also if we look at the prices charged on the 10th of each month. The first two groups, in fact, charge a higher price than the other groups (3 and 4). These prices, however, are lower than the average value for the two groups.

Table 5. Structure of Spanish prices in the fuel market by groups

Group	Price	Mean price	Std. Dev	Min	Max
Group 1	average price	1.091	0.085	0.759	1.379
	average price on the 10th	1.084	0.086	0.796	1.347
Group 2	average price	1.068	0.089	0.796	1.340
	average price on the 10th	1.062	0.088	0.796	1.340
Group 3	average price	1.042	0.091	0.768	1.384
	average price on the 10th	1.039	0.091	0.768	1.384
Group 4	average price	1.007	0.094	0.76	1.336
	average price on the 10th	1.007	0.091	0.76	1.336
Motorway	average price	1.095	0.084	0.82	1.339
	average price on the 10th	1.084	0.085	0.845	1.309

Before starting with the estimations of the first approach, we introduce the different variables one at a time, to understand the relationship between each group of variables (Brent, days of the week, dummy10th) and the dependent variable. Results for Model 1 are reported in Table n.6.

Table n.6 Variables specifications in Model 1

	Dependent variable: Price			
	1	*2*	*3*	*4*
	Estimate	*Estimate*	*Estimate*	*Estimate*
Intercept	1.09309***	1.09363***	1.09661***	1.09447***
	(0.00004)	(0.00004)	(0.00002)	(0.00004)
Dummy10			-0.00016***	-0.00008***
			(-0.00001)	(0.00001)
Tuesday		0.00030***		0.00029***
		(0.00001)		(0.00001)
Wednesday		0.00029***		0.000278***
		(0.00001)		(0.00001)
Thursday		0.00028***		0.00027***
		(0.00001)		(0.00001)
Friday		0.00034***		0.00030***
		(0.00001)		(0.00001)
Saturday		0.00027***		0.00024***
		(0.00001)		(0.00001)
Sunday		0.00017***		0.00014***
		0.00002		(0.00001)
Brentlitro	0.01089***			0.00847***
	(0.00047)			(0.00048)
				0.6003
R^2 *Overall*	0.63	0.1	0.02	0.6
F test	523.16	283.09	122.62	254.9
Observations	4,967,470	4,843,162	4,967,470	4,843,162

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

We omit to report stepwise results for Model 2 and 3 as they are coherent with those of Model 1. Full models for the three specifications of the first approach are reported in Table 7. We observe that the variable *Brent* affects the price positively in all the three models. A further common feature is related to the days of the week. We observe that they always affect the price positively compared to Mondays, and that this effect is larger in the first part of the week and it decreases during the weekend. Monday is, thus, the cheapest day of the week. This result is in line with Jimenez and Perdiguero (2013). They show that on Mondays the price falls more than the other

days of the week and that this “Monday effect” creates some distortions in the rank position of Spain in European statistics.

The *Dummy10th* variable is the most important for our analysis. We observe that the 10th day of the month, in Spain, has a negative and significant sign in models 1 and 2. In the first estimation, there is a reduction 0.00009 on the price of the 10th day, and in the second one there is a reduction of 0.00008. In both cases coefficients are statistically significant at the 1% level. Considering our dataset, with about 5 million observations, and the very good fit of the model, we can state that the price of diesel decreases on the 10th day of each month.

A relevant observation also stems from model 3. In this model we consider the fuel stations located on motorways and we observe that the variable *Dummy10th* is negative but not significant. This is expected as most people who are unemployed are unlikely to use motorways for both driving and refuelling. This is a good result for our analysis because it shows that the behaviour of fuel stations located on a motorway is not affected by the unemployment subsidy. In order to meet the conditions of a natural experiment, in fact, the control group must not be affected by the treatment.

Table n.7 Results of the first approach

	Dependent variable: Price		
	Model 1	*Model 2*	*Model 3*
	Estimate	*Estimate*	*Estimate*
Intercept	1.09447***	1.09364***	1.13498***
	(0.00000)	(0.00000)	(0.00002)
Dummy10th	-0.00009***	-0.00008***	-0.00014
	(0.00001)	(0.00002)	(0.00009)
Tuesday	0.00029***	0.00029***	0.00037***
	(0.00001)	(0.00001)	(0.00005)
Wednesday	0.00028***	0.00028***	0.00020***
	(0.00001)	(0.00001)	(0.00006)
Thursday	0.00027***	0.00026***	0.00038***
	(0.00001)	(0.00001)	(0.00007)
Friday	0.00031***	0.00029***	0.00068***
	(0.00001)	(0.00001)	(0.00006)
Saturday	0.00024***	0.00024***	0.00038***
	(0.00001)	(0.00001)	(0.00006)
Sunday	0.00014***	0.00014**	0.00023***
	(0.00001)	(0.00001)	(0.00005)
Brentlitro	0.00848***	0.00915***	0.00682**
	(0.00049)	(0.00050)	(0.00279)
Overall R^2	0.6003	0.6039	0.5783
F test	254.90	246.63	21.66
Observations	4,843,162	4,688,649	154,485

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Model 1=general model; Model 2=motorway==0; Model 3=motorway==1.
Source: Own estimation

In the second approach, we consider the difference-in-differences methodology (Table n.8). As stated before, the *"DIDgroup"* variables are the result of the interaction of the *Dummy10th* and each affected group dummy. The affected groups are represented by different types of fuel retailers that are not located on motorways. Specifically, we observe that the "large companies" (*DIDgroup1*) reduce the prices on the 10th of each month by approximately 0.00029 euro more than traditional operators, with a 1% level of significance. Surprisingly, the third group, i.e. the independent gas stations (*DIDgroup3*) has the largest increase in price. This group, in fact, increase their price on the 10th day of the month by 0.00022, followed by the "low-cost fuel

stations" (*DIDgroup4*) which increase the price of 0.00020. Consistently with previous estimates, the *Brentlitro* variable affects positively the fuel price.

As already explained (Table n.4), the "large oil companies" represent the group with the largest market share in the fuel market (57%)[16]. It may thus seem a contradiction that these operators are those that decrease the prices on the 10th of the month. Unemployed people, who are the beneficiary of the subsidy, are, however, a specific part of the market. They choose independent and low-cost companies, mainly for two reasons.

The first reason is that the price can be, on average, on any given day, lower than that of other companies. We interpret this unexpected price reduction adopted by major stations as a form of incentive to attract people on low incomes. A credible argument lies in the "supply-demand" law: if demand increases, companies tend to raise prices.

The second reason is related to the value of time[17]. The best and most easily accessible places are occupied by major companies while independent and low-cost petrol stations are not located in the city centre. Grant recipients, by definition, do not have a full-time job or employment, so they have more time than other individuals. This means that if a consumer is poor and unemployed, he/she has more time and cares more about prices than other consumers, so the likelihood of choosing to refuel in a low-cost company is greater. The time variable strongly influences consumer behaviour. Evidence shows that when unemployed people receive their monthly amount of money, low-cost fuel and independent retailers increase the price, whereas major companies set a lower price. Specifically, we obtain evidence pointing to a strategic behaviour of low-cost pump stations. They seem to exploit needy consumers by relying on their "habit" of finding lower prices. Moreover, major petrol stations have the opposite strategic behaviour. They reduce prices in order to gain a share of consumers with a greater "temporary" availability of money.

As a robustness check, we have developed a last model with which we test the effect of the policy on all four groups and on stations operating on the free highway, using toll motorway stations as control group. As we expected, the results are significant and positive for the different groups (except group 1) and negative but not significant for the free motorway group. These additional results (reported in the Appendix) confirm our previous findings.

[16] Our data is representative of the Spanish gasoline market since, according to BCG y CNE (2012), the major oil companies account, in Spain, for 60% of the market.

Table n.8 Results of second approach

	Dependent variable: Price
	Model 4
	Estimate
Intercept	1.09364***
	(0.00000)
DID Group 1	-0.00029***
	(0.00002)
DID Group 2	0.00012***
	(0.00004)
DID Group 3	0.00022***
	(0.00003)
DID Group 4	0.00020***
	(0.00006)
Tuesday	0.00029***
	(0.00001)
Wednesday	0.00028***
	(0.00001)
Thursday	0.00026***
	(0 .00001)
Friday	0.00029***
	(0 .00001)
Saturday	0.00024***
	(0.00001)
Sunday	0.00014***
	(0.00001)
Brentlitro	0.00915***
	(0.00050)
Overall R^2	0.5943
F test	201.42
Observations	4,688,649

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Source: Own estimation

6. Conclusions

This article analyses the behaviour of fuel stations in Spain to see if their pricing strategy is influenced by exogenous factors, i.e. increased availability of income. While the attention of the antitrust authority is increasingly focused on the activities of the major brands of oil companies and their service stations, our hypothesis is that the behaviour of service stations is differentiated, and that independent and low-cost service stations also discriminate against their consumers.

Many studies point out that low-cost companies apply lower prices and offer more favourable services to consumers (Hastings, 2004; Bergantino et al., 2018; Bernardo, 2018). Our results are consistent with these findings. In general, the prices of independent and low-cost operators are, in fact, lower than those of large brand stations. We note, however, that there is a specific effect on prices. In particular, independent retailers and low-cost companies increase their prices on the 10th of each month, while brand companies decrease their prices on this day. We find evidence that the former stations discriminate price when consumers in need have more disposable income. We therefore find indirect evidence of the so-called payment cycle problem in the fuel market. In line with the issue of payment cycles, in fact, it could be that there is an increase in demand for low-cost pumps, as drivers on unemployment benefit - more price-sensitive than generic consumers - generally refuel at stations that, on average, offer lower fuel prices during the rest of the month. Beneficiaries of the benefit are generally not recurring buyers and low-cost retailers benefit from their reputation. These same operators continue to be convenient for their regular consumers. Their prices are on average lower than those of branded stations. However, they take advantage of the temporarily higher income available to needy consumers and differentiate their prices accordingly. Branded stations, which on average sell their products at higher prices, are lowering prices on this particular day in order to attract more unemployed consumers to use their service stations.

These findings may have significant implications for the regulation of the fuel distribution market and may suggest the application of tailor-made policies for different types of operators. Low-cost fuel stations are increasing their presence in the European market, but few articles analyse in detail their pricing strategies. We fill this gap.

Future research should focus on increasing the number of years of observations in the analysis (according to the available data), and also on considering individual regions of Spain with different unemployment rates to observe how the heterogeneity of the unemployment rate affects operator's pricing behaviour. Further analysis could also focus on petrol prices to see

whether price patterns are similar between different fuel types. Finally, other forms of payment (e.g. wages, pensions, etc.), with their specific timing, could be considered.

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Appendix: ***Robustness check***

	Dependent variable: Price
	Model 5
	Estimate
Intercept	1.09415*** (0.00037)
Did Group 1	-0.00028*** (0.00002)
Did Group 2	0.00011*** (0.0004)
Did Group 3	0.00021*** (0.00003)
Did Group 4	0.00020*** (0.00006)
DID Free Motorway	-0.00009 (0.00009)
Tuesday	0.00029*** (-0.00008)
Wednesday	0.00028*** (0.00001)
Thursday	0.00026*** (0.00001)
Friday	0.00031*** (0.00001)
Saturday	0.00023*** (0.00001)
Sunday	0.00014*** (0.00009)
Brentlitro	0.00873*** (0.00048)
Overall R^2	0.59
F test	188.34
Observations	4,843,162

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Source: Own estimation