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AN ANALYSIS OF ANTICOMPETITIVE BEHAVIOUR ON THE RETAIL FUEL MARKET ACROSS DIFFERENT CENTRAL AND EASTERN EUROPEAN COUNTRIES

Abstract. *This paper aims to apply a cartel screening on the fuel retail market in six different countries from Central and Eastern Europe, namely Romania, Austria, Bulgaria, Czech Republic, Poland, and Hungary. Being a market with traits conducive to cartel formation, competition problems may easily occur on this market. By using comparative analysis of the fuel price level in the selected countries, between 2009 and 2021, as well as the Difference-in-Differences (DID) approach, the study finds that in the period between January 2013 and January 2016 the average prices practiced in Bulgaria for both gasoline and diesel were approximately 10% higher than those practiced on the other five geographic markets considered in the analysis. Thus, the main result of this paper is that, on the retail fuel market of Bulgaria, it is most likely that an anticompetitive agreement took place.*

Keywords: *cartels, fuels, competition, prices, Difference-in-Differences*

JEL Classification: C10, D43, L13, L41

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1. Introduction

Cartels are considered to be the most serious violations of competition rules, and their detection and punishment are a priority for competition authorities around the world. In the European Union, Mario Monti, the former competition commissioner, described cartels as "cancers on the open market economy" (European Commission, 2000), and the United States Supreme Court referred to cartels as "the supreme evil of antitrust" (Verizon Communications v. Law Offices of Curtis V. Trinko, 540 U.S. 398, 408 (2004)).

Cartel agreements are harmful to consumers and society as a whole, as they lead to higher prices, lower quality, and a narrower range of products than in a competitive market, generating an obvious loss of welfare. Such agreements discourage businesses from providing products and services at competitive prices, forcing consumers to pay more for the same product or for a product of lower quality.

The main cartel detection sources of information are the leniency applications, complaints, and external information, used by competition authorities. In addition to reactive detection approaches, however, there are also proactive approaches increasingly used by competition authorities, in particular, the monitoring of markets and the use of screenings with the help of economic analysis. Such approaches can be complementary tools, supporting the reactive detection of cartels and increasing the overall effectiveness of detecting anti-competitive agreements. At the same time, they have a strong deterrent effect: if cartel participants knew they were being monitored and their behaviour was constantly being analysed by the authorities, then they would realise that there is a high risk of detection and may choose not to enter such an agreement and can choose to comply with the competition rules.

Economic analysis gains an increasingly important place among the proactive methods used by the authorities in the fight against cartels. Whether it is an ex-ante systematic structural analysis of the main sectors in an economy to identify those markets with a high risk of cartelisation or an ex-post empirical analysis to assess to what extent the behaviour of certain undertakings corresponds to a competitive behaviour or, rather, collusive behaviour, these tools, called cartel screenings, generate evidence both for triggering investigations and for establishing the existence of cartels.

This article aims to test the effectiveness of a cartel screening based on the price level assessment using a comparative analysis of the fuel retail price in six different geographic markets, as well as a Difference-in-Differences (DID) analysis. We apply the cartel screening on the fuel retail market in six different geographic markets, namely Romania, Austria, Bulgaria, Czech Republic, Poland and Hungary, over the period between 2009 and 2021.

2. Literature Review

Several economic studies have found certain indicators or markers that can occur as a result of the existence of a cartel, differentiating a collusive environment from a competitive one (Harrington, 2006; Jimenez and Perdiguero, 2012; Abrantes-Metz, 2013). Table 1 is an illustration of them.

Table 1. Collusive markers

Type of collusive marker	Description
Price	A higher list (or regular) price and reduced variation in prices across customers
	A series of steady price increases is preceded by steep price declines
	Price rises and imports decline
	Firms' prices are strongly positively correlated
	A high degree of uniformity in product price and other dimensions including the prices for ancillary services
	Low price variance
	Price is subject to regime switches
Quantity	Market shares are highly stable over time
	There is a subset of firms for which each firm's share of total supply for that subset of firms is highly stable over time
	A firm's market share is negatively correlated over time

Source: Hüschelrath (2010), based on Harrington (2006)

In addition to these studies, price parallelism, price insensitivity to changes in costs or changes in demand conditions, abrupt changes in prices that cannot be explained by the evolution of demand or costs, or the appearance of the "rockets and feathers" phenomenon (prices rise faster in the case of an increase in the price of raw materials and decrease more slowly in the case of a decrease in the price of raw materials) commonly constitute signals concerning the existence of a cartel in the economy (Silveira et al., 2021; Jiménez and Perdiguero, 2012; Eckert and West, 2004).

In the economic theory, collusion is a situation where firms prices are higher than some competitive benchmark (Motta, 2004). Since the primary effect of a cartel is a price increase, the first sign that may indicate the existence of cartel activity is a higher level of price (Lewis, 2015; Boroumand et al., 2014).

Numerous studies indicate that if a cartel is effective, it is highly likely to have an influence on prices, either directly or indirectly, as a result of a price fixing agreement or, for example, as a result of a market sharing agreement (Porcher and Porcher, 2014; Clark and Houde, 2013, Balmaceda and Soruco, 2008). Based on 114 analysed cartels, a research conducted for the European Commission discovers that in 93% of cases, the cartels cause an overcharge (European Commission, 2009). But one often asked topic is how much a cartel can raise prices. Posner (2001) investigated overcharges in twelve cartel cases and found a median overcharge of 28% of the cartel price. Based on a study of cartel cases that occurred in OECD member countries between 1996 and 2000, the OECD (2002) discovered that the median value of the overcharge was around 13% and 16% of the cartel price. Oxera (2009) revealed a median overcharge of 18% based on an investigation of 114 cartel cases, of which 52 international cases and 62 national cartel cases. As a result, a higher average price may be an indicator of a cartel, especially if the price increase does not appear to be explained by cost or demand changes.

3. Description of the Fuel Retail Market

The motor fuel retail sector is an important sector in the Romanian economy, impacting the growth of other economic sectors both directly and indirectly. Because road transport is the most common mode of transportation in Romania, the fuel price is of a particular interest to consumers and it is frequently the focus of politicians and authorities due to its importance.

There are numerous characteristics of the Romanian fuel market that facilitate the presence of cartels and allow companies to easily coordinate.

In Romania, the fuel retail market resembles an oligopoly, with a small number of internationally active oil companies - OMV Petrom, Rompetrol, Lukoil, Mol, and Gazprom - accounting for approximately 90% of the market, followed by numerous independent companies that manage one or several gas stations (Competition Council, 2019). Moreover, the major oil companies are largely vertically integrated, with activities in oil exploration, production, refining, wholesale distribution, and retail through gas stations.

Furthermore, the barriers to entry on the market are considered high, being represented by major investments to build gas stations, as well as a high number of authorisations.

In addition, the fuel retail sector is distinguished by a high degree of transparency, with prices posted at the pump and widely accessible to competitors. Additionally, the Romanian Competition Council's development of the fuel prices platform has increased market transparency for both consumers and fuel companies. Since July 2019, the main players on the market have sent to a real-time prices platform every price change made inside their own network for five products: standard gasoline, premium gasoline, standard diesel, diesel premium,

and LPG. In this case, price transparency has two functions. On the one hand, data enables consumers to make informed decisions about fuel purchases and choose the best price, while simultaneously promoting price competition among fuel companies. On the other hand, this system enables an easier monitoring of competitors' prices, avoiding the potential time and transportation expenses required to gather the prices shown in gas stations in a specific local market and offering the monitoring mechanism which is essential in case of collusion.

These structural characteristics, as well as the product homogeneity, the inelasticity of demand to the price, the low degree of innovation, the multimarket contact and the absence of a countervailing power of final consumers facilitate coordination on the market.

Considering all these aspects, it can be concluded that, from a structural point of view, the motor fuel retail sector constitutes a vulnerable sector to cartel behaviour, being suitable for an in-depth screening, in order to verify whether there are anomalies in the observable behaviour of businesses which would indicate a collusive rather than a competitive environment.

First of all, the comparison between the evolution of fuel prices at pump and the international price of crude oil is absolutely relevant, which is the main input and the most important cost element of fuel.

Figure 1 illustrates the relationship between retail prices of gasoline and diesel (without taxes) on the Romanian market, on one hand, and the crude oil price, on the other one, from January 2008 to December 2021, indicating extremely similar developments of the two price categories. In June 2008, the oil price reached a peak of $141.07 per barrel, then dropped dramatically by the end of the year, hitting about $35 per barrel 5 months later in December 2008, thus marking the start of the economic crisis. Subsequently, the price of oil gradually increased until 2011, when it fluctuated around 110 dollars per barrel. In the backdrop of an oversupply and moderate fluctuations in global fuel demand, prices fell significantly in the second half of 2014, decreasing from around 110 dollars per barrel in June 2014 to around 30 dollars per barrel in January 2016. The decline of crude oil price on international markets, during this time period, triggered similar actions in Romania concerning pump prices of petroleum products. At the beginning of 2016, prices began to rise again, as uncertainties about future economic growth diminished and inventory growth slowed down. Between 2016 and 2019, there was an overall upward trend for both the Brent oil prices and fuel sales prices, with negative variations in June-July 2017, as well as at the end of 2018. After reaching 85 dollars a barrel in October 2018, the price of crude oil dropped by approximately 40% by the end of the year, determined by significant changes in the level of oil production. In this context, during December 2018, OPEC members and other oil producers agreed to reduce production. Following a substantial decline by the end of 2018, the price of oil registered a positive evolution, recovering some losses in 2019. Later, in the spring of 2020, crude oil price dropped dramatically during the early months of the pandemic amid

unprecedented collapse in oil demand, starting to recover beginning with the following months.

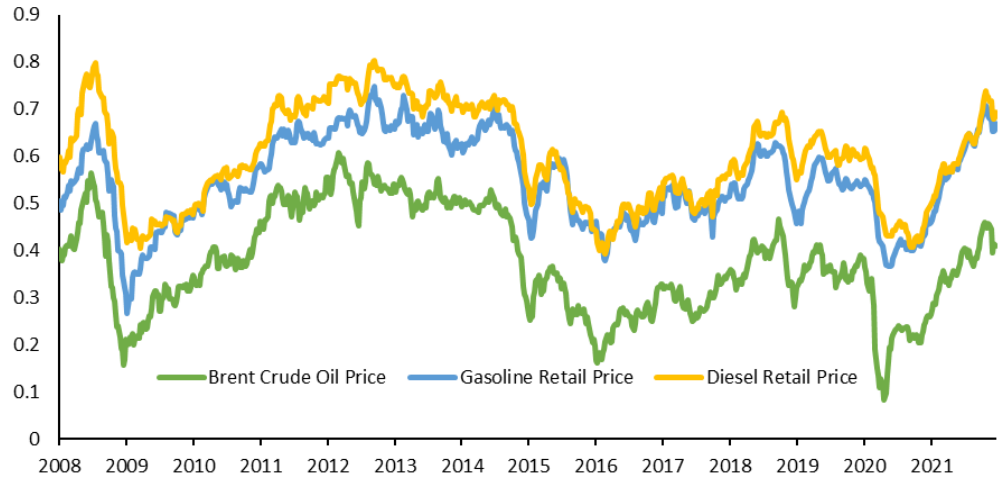

Figure 1. The evolution of average weekly prices without taxes of motor fuels in Romania and of Brent oil (euro/liter) in the period 2008-2021
Source: Graphic illustration based on data provided by Weekly Oil Bulletin and EIA

Even without a formal analysis, it is easy to observe that for most of the last decade, the pump average prices in Romania, for gasoline and diesel, have closely followed the evolution of the price of Brent oil.

To determine whether the price level in a given market matches a competitive level, comparator-based methods can be applied, such as comparison over time in the same market, comparison with data from other geographic markets, or comparison with data from markets of similar products, provided that the market or the period with which the comparison is made is unaffected by anticompetitive behaviour and thus a reference point is established.

Figure 2 illustrates the evolution of pump prices for gasoline and diesel on the Bulgarian market, as well as the evolution of the international crude oil price. At first glance, there seems to be a rigidity of pump prices in certain periods, especially in the period 2012-2016, when it can be observed that the players on the Bulgarian fuel market slightly reacted to changes in the crude oil price. It is also worth mentioning that, as illustrated in Figure 4, the fuels prices significantly dropped in February 2016, right after the Bulgarian Competition Protection Commission launched its investigation, a change that cannot be explained by the evolution of the international crude oil price. Therefore, the pump prices on the Bulgarian market decreased in February 2016 by 21% for gasoline and 28% for diesel, while the price of crude oil increased by 14% in the same month.

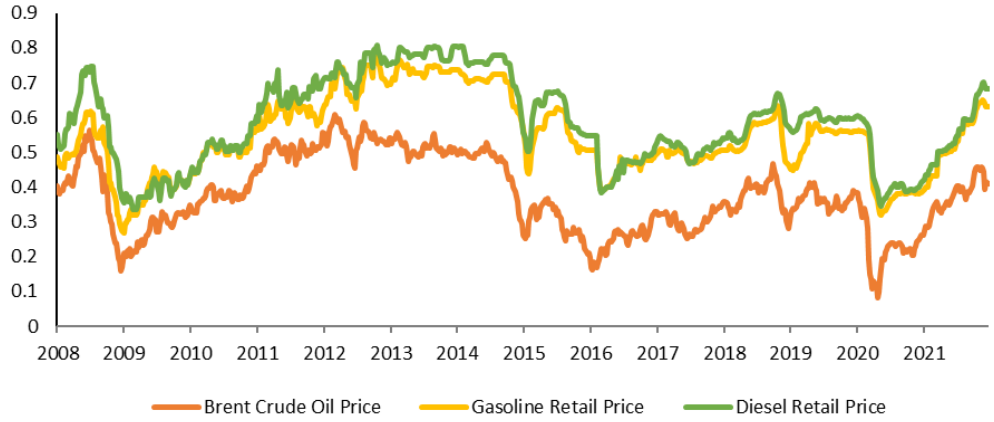

Figure 2. Evolution of the average weekly price without taxes for motor fuels and Brent oil (euro/liter) in Bulgaria in the period 2008-2021
Source: Graphic illustration based on data available Weekly Oil Bulletin

Figure 3 shows the evolution of gasoline and diesel prices in Bulgaria between January 2008 and December 2019, as compared to those in Romania. This comparison indicates that, in the first period, prices in Bulgaria and Romania vary around the same trend, with slight gaps observed in these two countries, and, in the case of diesel, the price in Romania is temporarily higher than the selling price observed in Bulgaria. In the period between the end of 2012, up to the beginning of 2016, fuel prices in Bulgaria reached a significant higher level, in contrast with the ones from Romania, in the same period of time. Following that, fuel prices in Bulgaria dropped, reaching comparable levels to those from Romania and even below in 2020-2021.

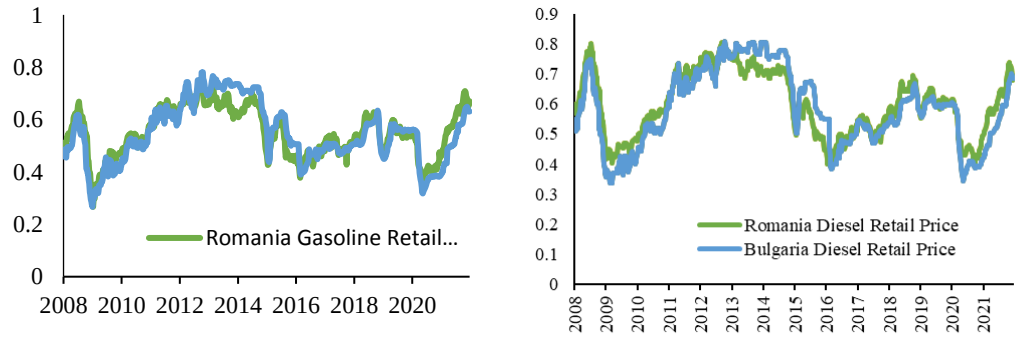

Figure 3. The evolution of the average weekly price without taxes for gasoline and diesel in Bulgaria and Romania in the period 2008-2021 (euro/liter)

Source: Graphic illustration based on data available in the Weekly Oil Bulletin

Going further in detail, the period 2008-2019 was divided into 3 sub-periods. Given the strong indications of the existence of a cartel on the Bulgarian market since the end of 2012 until the initiation of the investigation by the Bulgarian competition authority in February 2016, the three sub-periods are: January 2008 - December 2012 (sub-period no.1), January 2013 - January 2016 (sub-period no. 2), February 2016 – December 2019 (sub-period no. 3). Considering that the 2020-2021 period was marked by significant turbulence considering the pandemic context, this period was eliminated from the present analysis.

For each sub-period, the average, minimum, and maximum values of gasoline and diesel prices in Austria, Bulgaria, the Czech Republic, Poland, Romania, and Hungary were determined, presented as it follows: in Table no. 2 values related to sub-period no. 1, in Table no. 3 values related to sub-period no. 2 and in Table 4 the values related to sub-period no. 3. Thus, a comparison can be made of the pump prices in Bulgaria, compared to the other countries under analysis, namely Austria, the Czech Republic, Poland, Romania, and Hungary, before, during, and after the alleged cartel period.

Table 2. Average, minimum and maximum values of gasoline and diesel prices without taxes for the period January 2008 - December 2012 (euro/liter)

Price	**Avg.**	**Min.**	**Max.**
Gasoline_BG	0.5395	0.2669	0.7808
Gasoline_RO	0.5589	0.2666	0.7481
Gasoline_AT	0.5398	0.2446	0.7634
Gasoline_CZ	0.5728	0.2616	0.7856
Gasoline_PL	0.5547	0.2567	0.7546
Gasoline_HU	0.5795	0.2987	0.8120
Gasoline_EU	0.5689	0.2789	0.7877
Diesel_BG	0.5806	0.3359	0.8076
Diesel_RO	0.6237	0.4046	0.8029
Diesel_AT	0.5690	0.2789	0.7877
Diesel_CZ	0.6388	0.3789	0.8458
Diesel_PL	0.6134	0.3695	0.8202
Diesel_HU	0.6412	0.3918	0.8411
Diesel_EU	0.6247	0.3852	0.8116

Source: Own calculations based on data available in the Weekly Oil Bulletin

Table 3. Average, minimum and maximum values of gasoline and diesel prices without taxes for the period January 2013 - January 2016 (euro/liter)

Price	Avg.	Min.	Max.
Gasoline_BG	0.6581	0.4380	0.7662
Gasoline_RO	0.5977	0.4269	0.7287
Gasoline_AT	0.5901	0.3849	0.7076
Gasoline_CZ	0.5802	0.3699	0.6889
Gasoline_PL	0.5902	0.3556	0.7063
Gasoline_HU	0.6108	0.4044	0.7603
Gasoline_EU	0.6053	0.3946	0.7194
Diesel_BG	0.7092	0.5010	0.8057
Diesel_RO	0.6449	0.4008	0.7698
Diesel_AT	0.6281	0.3703	0.7455
Diesel_CZ	0.6491	0.4083	0.7551
Diesel_PL	0.6264	0.3594	0.7566
Diesel_HU	0.6577	0.3896	0.7907
Diesel_EU	0.6363	0.3631	0.7656

Source: Own calculations based on data available in the Weekly Oil Bulletin

Table 4. Average, minimum and maximum values of gasoline and diesel prices without taxes for the period February 2016-2019 (euro/liter)

Price	Avg.	Min.	Max.
Gasoline_BG	0.5093	0.3899	0.6342
Gasoline_RO	0.5181	0.3778	0.6284
Gasoline_AT	0.5063	0.3699	0.6199
Gasoline_CZ	0.4825	0.3264	0.5758
Gasoline_PL	0.5068	0.3460	0.6095
Gasoline_HU	0.5153	0.3720	0.6220
Gasoline_EU	0.5143	0.3666	0.6159
Diesel_BG	0.5403	0.3841	0.6695
Diesel_RO	0.5597	0.3938	0.6942
Diesel_AT	0.5440	0.3720	0.6936
Diesel_CZ	0.5334	0.3570	0.6534
Diesel_PL	0.5384	0.3463	0.6595
Diesel_HU	0.5658	0.3909	0.7072
Diesel_EU	0.5432	0.3570	0.6836

Source: own calculations based on data available in the Weekly Oil Bulletin

Analysing the findings reported in Tables 2, 3 and 4, it is determined that between January 2008 and December 2012 and February 2016 and December 2019, Hungary seems to have the highest average prices for both motor fuels, with a level above the European average price level. However, between January 2013 and January 2016, Bulgaria had the highest average price for both fuels. In the same period, Bulgaria reached the highest price levels for both fuels with 0.7662 euro/liter for gasoline and 0.8057 euro/liter for diesel. Furthermore, both in sub-period no. 1 (January 2008-December 2012) and in sub-period no. 3 (February 2016-December 2019), Bulgaria was among the countries with the lowest gasoline and diesel prices, dropping below the European average.

4. Methodology

For the purpose of the econometric analysis, time series with a weekly frequency covering the period January 2008–December 2019 were used. For the retail prices of the two fuels, gasoline and diesel, the average prices without taxes were used, expressed in euros/1000 liters, and for the crude oil, the spot price of Brent oil, expressed in dollars/barrel, was used as a proxy variable. The data series come from the databases of the European Commission (Weekly Oil Bulletin) for the average prices of the two motor fuels and from those of the American agency Energy Information Administration (EIA) for the price of Brent oil. In order to create comparable datasets, both gasoline and diesel pump prices and Brent oil spot prices have been converted to Euro/liter data with a weekly frequency. The use of fuel prices without taxes in the analysis was chosen to eliminate the effect generated by the different fiscal policies of the analysed states. The price behaviour is analysed both on the Romanian market and on five other European markets, namely Austria, Bulgaria, the Czech Republic, Poland, and Hungary.

In view of the econometric estimates, a preliminary analysis was performed regarding the stationarity of the time series used. A time series is stationary when its mean and variance are constant over time; in other words, its values oscillate around an equilibrium level. When a time series is non-stationary, the results of econometric models based on regression techniques can be distorted.

To test the stationary of the time series used, the Augmented Dickey-Fuller unit-root test was used. This test is a stationarity testing method that has as its null hypothesis the assumption that the data series is not stationary and consists of estimating the following regression model:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{t=1}^{p} \alpha_i Y_{t-1} + \varepsilon_t \quad (1)$$

where:

Y_t is the variable tested for stationarity;

δ represent the lags used to identify possible higher-order autocorrelations;

ε_t represents the white noise error term.

As mentioned, the test has the null hypothesis δ=0.

In this context, in order to stationarise the time series, the data is logarithmised and the first difference operator is applied:

$$DL(Y_t) = \log(Y_t) - \log(Y_{t-1}) \quad (2)$$

The series processed in this way are tested for stationarity at the 1% significance level. These operations transform level price series into weekly percentage price changes, while ensuring comparability between the analysed series. Therefore, the weekly percentage changes in prices, stationary time series, will be used in the econometric analysis.

Next, to test whether a certain price has a competitive level in a certain period, the temporal comparison of "before and during" or "during and after" type is used, assuming that "before" or "after" the market is functioning normally. Since a comparison over time in the same market is not always relevant in the case of fuel prices due to the considerable volatility of the price of crude oil, the main component of the pump price of fuel, furthermore, to solve this problem, a DID methodology is applied (Dewenter and Heimeshoff, 2012; Chu and Meisen, 2011). This approach considers that it is likely that the difference between prices charged over time is not entirely caused by the cartel, but that it can be influenced and by other factors, such as changes in costs or demand.

The DID methodology consists of comparing two groups of individuals, the "treated group" and the "control group", in two different time periods. Thus, the price evolution of the affected products, defined as the "treated group" during and before or after the alleged cartel period is compared with the price evolution in the same period of similar products or of same products from another geographic market that were not affected by the anticompetitive behaviour considered, respectively, the "control group". It is assumed, then, that all factors affecting the "treated group" similarly affect the "control group" and thus the difference in the evolution of the treated group is compared with the difference in the evolution of the control group, during and before or after the cartel. The importance of this analysis lies in its ability to better control the effects of certain factors that can influence the analysed prices over time (the effect of possible changes in costs, demand, macroeconomic conditions, market characteristics), eliminating them at the same time and obtaining thus the price change caused by the cartel. The DID method is briefly presented in Table no. 5.

Table 5. The "Difference in Differences" (DID) Approach

	Cartel period	**The post-cartel period**	**The difference**	**"Difference in Differences"**
The treated group	$P_{1.1}$	$P_{1.2}$	$\Delta P_1 = P_{1.1} - P_{1.2}$	$\Delta P = \Delta P_2 - \Delta P_1$
The control group	$P_{2.1}$	$P_{2.2}$	$\Delta P_2 = P_{2.1} - P_{2.2}$	

Source: own computation

A set of assumptions must be considered in this approach:

(i) the evolution of the prices of the products belonging to the "control group" over time coincides with the evolution of the prices of the products belonging to the "treated group" in the absence of coordination;

(ii) the "control group" is similar in terms of market structure, level of competition, costs and demand characteristics to the "treated group";

(iii) the "control group" is not affected by the cartel; otherwise, this approach tends to diminish the effect of the cartel and, implicitly, distorts the perspective on the competitive price level;

(iv) the period before or after the cartel will be chosen depending on the availability of data, the information held on the date when the cartel started or ended, as well as the degree of similarity with the way prices were formed during the cartel.

The DID approach can also be applied using a regression model, which has two main advantages: firstly, the statistical significance of the estimated coefficient can be tested, and secondly, the regression model allows the inclusion of some control variables that can explain certain price changes and thus improve the estimates made.

In this case, the regression equation can be written as follows:

$$P_{j,t} = \beta_0 + \beta_1 Period_t + \beta_2 Market_j + \beta_3 Period_t * Market_j + \beta_4 Ppetrol_t + \varepsilon_{j,t} \quad (3)$$

where:
$P_{j,t}$ is the fuel price in market j in period t;
$Period_t$ is a dummy variable that takes the value "1" during the cartel and "0" outside the cartel;
$Market_j$ is a dummy variable that takes the value "1" for the cartelised market j and "0" outside it;
β_3 is the interaction coefficient $Period_t$ * $Market_j$ that indicates the difference between the analysed price developments, so the impact of the cartel on the price;
$Ppetrol_t$ is the control variable, representing the price of Brent oil in period t.

In the regression analysis, we considered the average price for gasoline and the average price for diesel in Bulgaria as variables "to be treated", in turn, and as control variables, we took, in turn, the average prices practiced in the analysed countries, respectively, Austria, the Czech Republic, Poland, Romania and Hungary for both types of fuel. At the same time, the natural logarithm was applied to the price series, so that the coefficient of the regression equation β_3 can be interpreted as the percentage change in the price for gasoline, respectively, diesel practiced in Bulgaria as a result of the alleged cartel from January 2013 to January 2016.

5. Results and Discussions

The results of stationarity tests for the price of gasoline and the price of diesel in Austria, Bulgaria, the Czech Republic, Poland, Romania and Hungary, as well as for the price of Brent oil, are presented in Table no. 6.

Table 6. Stationarity test results for the analysed variables

Variable	t-Statistic	Prob.	First difference	t-Statistic	Prob.
Null hypothesis: the analysed data series have a unit root.					
Gasoline_AT	-2.474	0.1224	DL(Gasoline_AT)	-12.993	0.000
Gasoline_BG	-2.019	0.2786	DL(Gasoline_BG)	-13.122	0.000
Gasoline_CZ	-2.647	0.0840	DL(Gasoline_CZ)	-8.312	0.000
Gasoline_HU	-2.240	0.1924	DL(Gasoline_HU)	-20.502	0.000
Gasoline_PL	-2.693	0.0757	DL(Gasolinel_PL)	-9.155	0.000
Gasoline_RO	-2.238	0.1928	DL(Gasoline_RO)	-20.891	0.000
Diesel_AT	-2.010	0.2826	DL(Diesel_AT)	-16.175	0.000
Diesel_BG	-2.001	0.2864	DL(Diesel_BG)	-14.013	0.000
Diesel_CZ	-2.196	0.2081	DL(Diesel_CZ)	-9.228	0.000
Diesel_HU	-1.973	0.2987	DL(Diesel_HU)	-20.228	0.000
Diesel_PL	-2.178	0.2146	DL(Diesel_PL)	-10.053	0.000
Diesel_RO	-1.876	0.3436	DL(Diesel_R0)	-21.519	0.000
Oil_Brent	-1.932	0.3174	DL(Oil_Brent)	-21.498	0.000

Source: own calculations using Eviews 7.2

The results indicate that the analysed variables are not stationary in their level, being stationary in their first difference.

In a first stage, the evolution of the prices practiced in Bulgaria was investigated by comparison with the prices practiced in Romania. Finally, by difference, the impact of the alleged cartel on the market is obtained.

For the purpose of DID analysis, the following assumptions are made:

(i) the fuel retail market in Bulgaria represents the cartelised market;

(ii) the Romanian fuel retail market represents the reference market, it being unaffected by anti-competitive behaviour;

(iii) during the analysed period, both markets were similarly affected by the same factors;

(iv) the cartel practice ended in February 2016, at which time the Bulgarian Competition Protection Commission launched an investigation on this market

regarding the existence of potential cartel behaviour, therefore the period affected by the cartel is January 2013-January 2016, and the period of reference is February 2016-December 2019.

In this case, the DID approach can be written, most simply, as follows:

$$_{BG}cartel = \left(P_{BG,\ 2013\text{-}2016} - P_{BG,\ 2016\text{-}2019}\right) - \left(P_{RO,\ 2013\text{-}2016} - P_{RO,\ 2016\text{-}2019}\right) \quad (4)$$

Applying the DID method and using the average prices for gasoline and diesel in Bulgaria and Romania in the period 2013-2019 illustrated in Tables no. 3 and 4, the following results: the price of gasoline at the pump in Bulgaria "during the cartel" is 0.6581 euro/liter, and in the "after" period it is 0.5093 euro/liter. In Romania, the price of gasoline at the pump "during the cartel" is 0.5977, and in the "after" period it is 0.5181. Thus, the "difference in differences" analysis indicates an overprice in Bulgaria, compared to the Romanian market, of 0.0692 euro/liter, determined by the difference between the two differences (in Bulgaria, there is a difference of 0.149 euro/liter between the two periods, and in Romania there is a difference of 0.079 between the same periods). In a similar way, the overprice related to diesel was determined, in the amount of 0.0837 euro/liter. The results are summarised in Table no. 7, both for gasoline and diesel.

Table 7. Estimation of cartel overcharge in the Bulgarian retail fuel market using the DID approach

Variable	**Period Jan. 2013-Jan. 2016**	**Period Feb 2016 – Dec 2019**	**The difference**
Gasoline_BG	0.6581	0.5093	0.1488
Gasoline_RO	0.5977	0.5181	0.0796
Diesel_BG	0.7092	0.5403	0.1689
Diesel_RO	0.6449	0.5597	0.0852

Source: own calculation in Eviews 7.2

Thus, as a result of the DID analysis, an overcharge of 10.5% for gasoline and 11.8% for diesel was found in Bulgaria between January 2013 and January 2016. The price difference is similar to that obtained by comparing the prices practiced in Bulgaria with those practiced in Romania in the same period (January 2013-January 2016), which resulted in a 10.1% overcharge in the case of gasoline and 9.97% in the case of diesel. Thus, in both situations, the overcharge identified is similar.

Next, we apply the DID approach to all the markets investigated, using the regression analysis, considering the prices charged on the Bulgarian market as treated variables. The regression equations were estimated by the OLS method (ordinary least squares), in Table no. 8 being illustrated the estimated results with the help of the regression model.

Table 8. Difference-in-differences regression model results

The reference variable	**coefficient β_3**	**Std. Error**	**Prob.**
Gasoline_RO	0.1135	0.0084	0.0000
Gasoline_AT	0.1025	0.0083	0.0000
Gasoline_CZ	0.0712	0.0092	0.0000
Gasoline_PL	0.1041	0.0085	0.0000
Gasoline_HU	0.0883	0.0083	0.0000
Diesel_RO	0.1330	0.0080	0.0000
Diesel_AT	0.1308	0.0084	0.0000
Diesel_CZ	0.0752	0.0092	0.0000
Diesel_PL	0.1213	0.0093	0.0000
Diesel_HU	0.1249	0.0080	0.0000

Source: own calculation in Eviews 7.2

As can be seen in the table above, the DID analysis confirms that the average prices of gasoline and diesel in Bulgaria were approx. 10% higher than the average prices recorded at the pump in the other markets analysed between January 2013 and January 2016. The biggest difference is between Romania and Bulgaria, of 11.35% in the case of gasoline and 13.30% in the case of diesel, and the smallest difference is recorded between Bulgaria and the Czech Republic, of 7.12% in the case of gasoline and 7.52% in the case of diesel.

The main results obtained from the analysis of the price level in the six analysed markets show similar price levels for most of the investigated markets, except for Bulgaria. Between January 2013 and January 2016, Bulgaria recorded the highest average price for both gasoline and diesel. The difference between the prices practiced in Bulgaria and the average price at the European level in the period 2013-2016 is 8.7% for gasoline and 11.4% for diesel. Moreover, both in the previous period (January 2008-December 2012) and in the subsequent one (February 2016-December 2019), Bulgaria was among the states with the lowest prices for both gasoline and diesel, ranked below the European average.

6. Conclusions

Cartels are undoubtedly the most serious restraints on competition. They lead to higher prices and fewer choices for consumers and also have a negative impact on the economy as a whole. The famous line of one of the participants in the international lysine cartel, "Our customers are our enemies", illustrates the negative impact that cartels have on customers and consumers and justifies the declared fight of the competition authorities around the world against cartels. In this context, a proactive policy to prosecute cartels is essential.

In this article, a methodology for testing potentially collusive behaviour is proposed, based on the price level, an indicator that is investigated through a comparative analysis of several geographic markets, as well as through a DID analysis.

The developed methodology is applied on the fuel retail sector in Romania and five other markets in Central and Eastern Europe, namely Austria, Bulgaria, the Czech Republic, Poland and Hungary. We have chosen to investigate the retail sale of motor fuels, as this sector is an essential one in any country's economy and generally presents numerous structural characteristics that make it prone to anticompetitive behaviour. Therefore, we believe that this sector needs to be constantly monitored.

Based on the results obtained on the six geographic markets analysed, it can be concluded that the retail fuel market in Bulgaria remains the market most likely to be cartelised. The DID approach confirms the higher level of pump prices in Bulgaria in the period January 2013-January 2016 and indicates an average gap of approx. 10% between Bulgaria and the other markets, eliminating at the same time the effects of the other factors that influenced the price evolution over time. Furthermore, the persistent price stability between January 2013 and January 2016, as well as the sudden break in prices at the beginning of 2016, with the launch of the investigation by the competition authority, suggest the existence of a cartel in this market.

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