AN INITIAL ANALYSIS OF PRICE EFFECTS OF SUBSIDIZING PETROL IN EUROPE*

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Abstract

The increase in international petroleum prices generated by Russia's invasion of Ukraine is one of the main causes of inflation, especially in Europe. In order to contain it, 13 European countries have introduced tax reductions or subsidies so as to reduce the final diesel and gasoline 95 prices paid by consumers. However, these markets have shown both inelastic demand and concentrated markets which affect pass-through. Using weekly data for 24 European countries between January and May, 2022, this paper analyzes the effect of these measures on diesel and gasoline 95 prices. The difference-in-difference estimator shows a high degree of heterogeneity between them, although on average approximately 70 percent of the tax reductions are transferred. Therefore, these measures are: inefficient, as only a small part has an impact on the final price paid by consumers; regressive (as they subsidize the richest); do not fight climate change, and finance Russia as a petrol exporting country.

Keywords: Ukraine crisis; Petrol prices; Public policies; European Union

JEL Codes: **H2; L4; Q48;**

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1. Motivation

With the 2008 global financial crisis, the European Central Bank introduced a whole set of extraordinary monetary policy measures (especially the purchase of public debt from peripheral countries). This non-traditional monetary approach did not seem to cause a significant growth in inflation, despite generating a large increase in the money supply. Inflationary pressures only started to build from the start of 2022, as a consequence of expansionary policies, both fiscal and monetary, introduced in developed countries after the Covid-19 pandemia. These inflationary tensions worsened significantly in February 2022 with Russia's invasion of Ukraine and the large hike in oil and gas prices.

Specifically, since February 24, 2022, the price of gas has increased by 13.8% and the price of a Brent barrel by 22.3% (data obtained from the DEGIRO platform, referenced to June 30, 2022). Price-wise, Brent oil reached a high of 117.15 dollars per barrel on June 8, 2022, representing an increase of 85.7% compared to the previous year (interannual), and 39% since the Ukraine war began. It is clear that the conflict has generated instability in international energy markets, which may contage the rest of the economy.

In fact, consumer prices in various countries of the European Union (EU) have significantly risen from the scale of the war. Germany, for example, posted price increases in May 2022 of 7.9%; the highest rise since 1973. Faced with this escalation, many EU countries have introduced measures to try to control energy prices, and especially their economic repercussions.

In the case of fuel, measures have predominantly focused on: tax reductions (Croatia, Cyprus, Ireland, Belgium, Holland, France, Italy, Germany and Luxembourg); consumption subsidies (Portugal, Greece and Spain), and; the establishment of a cap on prices (Slovenia). These measures seek to put a break on fuel prices (which are inputs for the production of many other goods and services), which have an impact on the production system and, finally, inflation.

However, the actual effectiveness and efficiency of these measures need to be analyzed empirically. In particular, there are two fuel market characteristics that can mean that tax reductions and/or consumption subsidies are not fully passed on to consumers: 1) the inelasticity of demand and, 2) the market power of companies.

Regarding the former, numerous studies have shown how the elasticity of fuel demand is below 1, especially in the short term. As Espey (1998) demonstrated in his meta-analysis, fuel demand is inelastic, especially in the short term, because consumers do not have other products available, or the ability to change their vehicles for alternative energies (electricity, for example). After analyzing 363 short- and medium-term estimates, Espey found the average elasticity of demand was -0.26, with a median of -0.23. In the long term, elasticity is considerably higher, although fuel continues to be an inelastic product. Analysis of the 277 long-term demand estimates shows an average of -0.58, with a median of -0.43. This same study showed that demand elasticities could be significantly higher in Europe than in the United States (US), although only in the short term. In fact, Espey (1996) analyzed, through a meta-analysis, the elasticity of demand in the US and found that the sample had an average elasticity of -0.53. Hanly et al (2002) performed another meta-analysis showing very similar average elasticities: -0.25 in the short run and -0.64 in the long run. Brons et al (2008) find a similar result in a further meta-analysis, with a short-term elasticity of 0.34, and a long-term elasticity of -0.84. The authors conclude, therefore, that the demand for gasoline is not very sensitive to price. Cynthia-Lin and Prince (2013) further show that if price volatility takes account of consumer reaction, long-run elasticity is even slightly lower. For the European market, there are many other papers that have shown low elasticities of demand. Drollas (1984), for example, found very low demand elasticities in the short run for all European countries (see Table A.1 at annex).

In addition to low demand elasticity, we must consider that some countries have a highly concentrated market in which companies have the capacity to influence prices, and therefore to 'appropriate' part of the reduction in taxes or the consumption subsidy. There is solid empirical evidence that shows how market power is one of the factors that significantly influences the ability to transfer tax movements to final consumers, or not. Ganapati et al (2020), for example, show how imperfect competition is important in explaining why 100% of the interventions in the costs of energy products are not transferred, including increases or decreases in taxes. The authors show that approximately 70% of changes in the costs are passed on to final consumers. Similar results are found by Genakos and Pagliero (2022), who show how competitive markets (with four or more competitors) transfer 100% of changes in fuel costs, while monopolistic markets transfer 40%. Also, the adjustment speed is 60% faster in competitive markets.

The empirical evidence[1] is not only observed in the fuel sector. Delipalla and O'Donnell (2001) demonstrate how market power allows a greater transfer of taxes to consumers in the tobacco market. Miravete et al (2018) show how, with imperfect competition, companies in the alcoholic beverage market may not fully transfer the decrease in taxes introduced in Pennsylvania, thus generating a significant increase in the wholesale price. Pless and Van Benthem (2019) found a similar result in the solar panel market, showing that: companies appropriated 100% of the subsidy introduced by the California government; imperfect competition is the reason for this behavior, and end consumers do not pay significantly different prices.[2]

These two characteristics mean that it is not surprising how companies have the capacity to appropriate part of tax cuts or consumption subsidies. Doyle Jr and Samphantharak (2008), for example, showed how the elimination of the tax on fuel sales in the states of Illinois and

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[1] For a theoretical explanation on the relationship between imperfect competition and tax transfers, see Weyl and Fabinger (2013).

[2] Another element that can have a significant influence is the existing vertical relationship in the market, as shown by Bonnet et al (2013) and Bajo-Buenestado and Borrella-Mas (2022). These studies show how vertically integrated companies have a greater capacity to transfer increases in costs to consumers, whether they are increases in the prices of inputs, or taxes. They would also have a greater capacity not to pass on the decreases in these costs to consumers. Many European gasoline markets are highly vertically integrated, so they would have a greater capacity not to pass on tax cuts or subsidies.

Indiana transferred only 70% to final prices. However, when the tax was restored, final prices increased between 80 and 100%. Likewise, the authors noted how service stations located near the border - as they had less competitive pressure - transferred the tax reduction to a lesser extent.

This paper analyzes the efficiency of the measures taken by European countries with the aim of reduce fuel prices, through a difference-in-difference estimator. Based on a panel of 24 European countries between January to May, 2022 (19 weeks), the results show that in most countries the measures have not been fully transferred to consumers, but rather that companies have taken advantage of these initiatives to increase their margins. In fact, approximately 30% of these measures does not result in a price decrease for consumers but in an increase in company margins.[3]

The structure of this paper is as follows: following this introduction, the next section details the database employed, as well as the different measures imposed by European countries. Section 3 shows the econometric specification used, as well as the results obtained. In section 4, the existence of parallel trends is analyzed and a placebo test are carried out. The last section presents the conclusions.

2. Data, policies and descriptives

In this paper we have built a weekly panel dataset of all European countries included in the Oil Bulletin (European Commission)[4], followed for the first 19 weeks of 2022. It includes information about weekly average prices of petrol 95 and diesel (with and without taxes), the average price of Brent (after applying euro-dollar exchange rate), and binary variables that control what countries employ public policies in their petrol markets. Specifically, our initial period is the first week of 2022 (03, Jan) and the final period is the week of 16, May.

The petrol price increase has led to the adoption of different policies in EU countries. The first country seeking to control the rise in fuel prices was Portugal, in October 2021, through a tax reduction in fuel, which became the most common EU measure. A month later, in November, Malta applied a similar measure. Also in November, Hungary decided to intercede in the fuel market by fixing a maximum price. In 2022, Poland was the first country to reduce VAT on gasoline to 8%, almost half the minimum established by the EU, which is set at 15%. This decision caused controversy within the EU because it was taken unilaterally and therefore required monitoring.

A few weeks later, the start of the Ukraine conflict produced a rise in fuel prices, which led to the introduction of further EU interventions. Tax reductions were gradually adopted by

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[3] A review of these ideas can be seen in https://www.economist.com/leaders/2022/03/26/cutting-fuel-taxes-is-a-bad-idea

[4] Raw data is available here: https://ec.europa.eu/energy/observatory/reports/List-of-WOB.pdf.

Belgium, Croatia, Cyprus, France, Germany, Ireland, Italy and Luxembourg, and other countries such as Sweden implemented after our period analysis (June, 2022).

An alternative policy to reduce fuel cost is the subsidy, which has been applied by Portugal, Spain and Greece. It should be noted that the subsidy made by Greece is conditional on income level. Countries included in the database, policies and dates, are shown in Table 1. In total, we have 453 observations related to 13 treated countries and 11 control countries (i.e. those unaffected by public policies in this market).

Table 1: Countries and policies (2022)

	Countries included	**Policy**	**Date (week started at...)**	**Description**
Treated group	Croatia	Tax reduction	March, 07	0.20 HRK/L for gasoline; 0.40 HRK/L for diesel
	Cyprus	Tax reduction	March, 07	0.07 €/L
	Ireland	Tax reduction	March, 07	0.20 €/L for gasoline; 0.15 €/L for diesel; 0.02 €/L for "green diesel"
	Portugal	Subsidy	March, 07	0.085 €/L
	Belgium	Tax reduction	March, 14	0.175 €/L
	Slovenia	Maximum price	March, 14	1.54 €/L for gasoline; 1.50 €/L for diesel
	Netherlands	Tax reduction	March, 28	0.173 €/L for gasoline; 0.111 €/L for diesel
	France	Tax reduction	March, 28	0.15 €/L
	Greece	Subsidy	March, 28	0.22 €/L (0.27 € for insular regions) until 60 litres; 0.15 € /L for diesel
	Italy	Tax reduction	March, 28	0.25 €/L
	Germany	Tax reduction	March, 28	0.30 €/L for gasoline; 0.15 €/L for diesel
	Spain	Subsidy	March, 28	0.20 €/L
	Luxembourg	Tax reduction	March, 28	0.075 €/L
Control group (no policies)	Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, Latvia, Lithuania, Romania, Slovakia and Sweden			

Source: own elaboration.

The database included the following covariates:

1. Price of petrol 95 (or diesel)$_{it}$: this is the average weekly price of petrol 95 or diesel, with or without taxes, in the country *i* in week *t*. Source: Oil Bulletin.
2. Brent$_t$: is the average weekly price of Brent oil per litre in euros, in week *i*. Source: Investing.com. As public prices are shown in dollars, the euro/dollar exchange rate was obtained from the European Central Bank website.
3. Treated Country$_i$: a binary variable that takes value 1 if the country *i* is treated, i.e., it is affected by some public policy after Ukraine's invasion. The control group (when this variable takes value 0) includes those countries not affected by policies (see Table 1).
4. After$_t$: binary variables that take value 1 for each country after the change in their petrol market public policy.

5. Difference-in-difference$_{it}$: binary variables that take value 1 if the country *i* is treated and week *t* is after the public policy was implemented in each country. This is our relevant variable (hereinafter, DiD). We split this into one for each country.

Table 2 shows descriptive statistics for petrol prices and statistical significance for the t-test. The before and after period t-test are given in the last column.

Table 2: Average petrol prices

	Before	After	t-test
Gasoline 95			
Prices with taxes. Treated countries	1.70	1.82	-4.24***
Prices without taxes. Treated countries	0.80	0.97	-12.08***
Prices with taxes. Control countries	1.57	1.80	-7.34***
Prices without taxes. Control countries	0.75	0.95	-17.49***
Diesel			
Prices with taxes. Treated countries	1.63	1.85	-9.77***
Prices without taxes. Treated countries	0.87	1.10	-13.50***
Prices with taxes. Control countries	1.51	1.85	-9.18***
Prices without taxes. Control countries	0.83	1.11	-12.74***

***, **, * represent 1%, 5% and 10% significance levels respectively. In the case of control countries, 'After' includes data from the last week of February, 2022.

As can be seen in the table above for both gasoline 95 and diesel, and for both prices before and after taxes, the increase is higher in the case of the control countries than in the affected countries. Therefore, it seems that in general terms the measures introduced could have generated a containment of fuel prices with respect to the countries that did not introduce any measure. In the following section, we implement a difference estimator in order to accurately estimate the effect for each of the countries that have introduced some economic initiative, and measure the extent to which the tax or subsidy is passed to the final price.

3. Estimations and results

The equation [1] includes the DiD estimator to obtain the causal effect of policies on petrol markets. In particular, the following regression is run on our sample:

$$P_{it} = \beta_0 + \beta_1 Treated_i + \beta_2 After_{it} + \beta_3 Treated_i * After_{it} + Brent_t + \alpha_i + u_{it} \quad [1]$$

where P_{it} is the price of petrol or diesel (with and without and taxes) of the country (*i*) at week (*t*); $Treated_i$ takes value 1 if the country (*i*) has implemented a petrol market policy and 0 otherwise (control countries); $After_{it}$ takes value 1 for the weeks in which the policy took place in each country and 0 before; $Treated_i * After_{it}$ is the interaction of both previous binary variables. Therefore, it takes value 1 for the countries treated during the period in which the policy was implemented, and 0 in all other cases (this is the DiD); $Brent_t$ is the cost of Brent per liter; α_i represents individual fixed effects (country); and u_{it} is the error term.

Table 2 includes estimations of equation [1] for petrol and diesel, with and without taxes. For simplicity, Treated and after covariates are not included. The DiD covariates per country shows the average effect of the policy in each one regarding the average change in control countries.

Table 3: Difference-in-difference

Variables	Diesel with taxes (1)	Petrol95 with taxes (2)	Diesel without taxes (3)	Petrol95 without taxes (4)
DiD Croatia	-0.0986***	-0.1095***	-0.0802***	-0.0650***
	(0.02)	(0.02)	(0.02)	(0.02)
DiD Cyprus	-0.1185***	-0.1355***	-0.0402**	-0.0515***
	(0.02)	(0.02)	(0.02)	(0.02)
DiD Ireland	-0.0957***	-0.1380***	0.0223*	0.0306***
	(0.02)	(0.02)	(0.01)	(0.01)
DiD Netherlands	-0.0699**	-0.1351***	0.0236	0.0262**
	(0.03)	(0.03)	(0.02)	(0.01)
DiD Portugal	-0.0907***	-0.0573***	-0.0185	0.0027
	(0.03)	(0.02)	(0.02)	(0.02)
DiD Belgium	-0.1110***	-0.1008***	0.0261	0.0383**
	(0.03)	(0.03)	(0.02)	(0.02)
DiD France	-0.1278***	-0.1444***	-0.1182***	-0.1294***
	(0.04)	(0.03)	(0.03)	(0.03)
DiD Greece	-0.0582**	0.0279	-0.0668***	0.0076
	(0.03)	(0.02)	(0.02)	(0.02)
DiD Italy	-0.2556***	-0.2686***	0.0247	0.0180
	(0.02)	(0.02)	(0.02)	(0.02)
DiD Slovenia	-0.2135***	-0.0920***	-0.1594***	-0.0750***
	(0.03)	(0.02)	(0.02)	(0.01)
DiD Germany	-0.0141	0.0004	-0.0213	-0.0075
	(0.04)	(0.03)	(0.03)	(0.02)
DiD Spain	0.0588***	0.0361**	0.0348***	0.0194
	(0.02)	(0.02)	(0.01)	(0.01)
DiD Luxembourg	-0.0292	-0.0198	0.0064	0.0149
	(0.03)	(0.02)	(0.03)	(0.02)
Brent (€ per liter)	0.6833***	0.6491***	0.6332***	0.5662***
	(0.07)	(0.05)	(0.06)	(0.04)
Treated and after covariates	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	453	453	453	453
R^2	0.95	0.97	0.95	0.92

***, **, * represent 1%, 5% and 10% significance levels respectively. Robust standard errors in parentheses.

As can be seen in the table above, most of the coefficients are significant and negative in the two columns that use prices after taxes. This means that at least part of the tax cuts or subsidies have been passed on to consumers. Likewise, columns three and four, where the prices before taxes are used, show a wide set of positive and significant coefficients (Ireland, Netherlands, Belgium and Spain, but not for both products), which indicates that the companies have managed to increase their prices with respect to the control countries, thereby appropriating part of the tax reduction or subsidy. However, with the coefficients of the difference estimator, it is difficult to specify the percentage of tax reduction or subsidy that has ended up in the hands of consumers.

In the following table we can observe the different transmission percentages of the tax reductions, as well as the subsidies introduced in the different countries.

Table 4: Pass-through of Diesel and Gasoline 95

Country	Economic policy: Tax reduction	Diesel with taxes	Pass through Diesel	Petrol95 with taxes	Pass through Petrol 95	Diesel without taxes	Δ Prices Diesel	Petrol95 without taxes	Δ Prices Petrol95
Croatia	0.4 HRK/L (Diesel) 0.2 HRK/L (Petrol95)	-0.0986***	185.3%	-0.1095***	301.5%	-0.0802***	-150%	-0.0650***	-244%
Cyprus	0.07 €/L (Diesel) 0.07 €/L (Petrol95)	-0.1185***	169.3%	-0.1355***	193.6%	-0.0402**	-60%	-0.0515***	-73%
Ireland	0.15 €/L (Diesel) 0.20 €/L (Petrol95)	-0.0957***	63.8%	-0.1380***	69%	0.0223*	14.9%	0.0306***	15.3%
Netherlands	0.111 €/L (Diesel) 0.173 €/L (Petrol95)	-0.0699**	63%	-0.1351***	78.1%	0.0236	21.3%	0.0262**	15.1%
Belgium	0.175 €/L (Diesel) 0.175 €/L (Petrol95)	-0.1110***	63.4%	-0.1008***	57.6%	0.0261	14.9%	0.0383**	21.9%
France	0.15 €/L (Diesel) 0.15 €/L (Petrol95)	-0.1278***	85.2%	-0.1444***	96.3%	-0.1182***	-78.8%	-0.1294***	-86.3%
Italy	0.25 €/L (Diesel) 0.25 €/L (Petrol95)	-0.2556***	102.2%	-0.2686***	107.4%	0.0247	9.9%	0.0180	7.2%
Germany	0.15 €/L (Diesel) 0.30 €/L (Petrol95)	-0.0141	9.4%	0.0004	-0.1%	-0.0213	-14.2%	-0.0075	-2.5%
Luxembourg	0.075 €/L (Diesel) 0.075 €/L (Petrol95)	-0.0292	38.9%	-0.0198	26.4%	0.0064	8.5%	0.0149	19.9%
Country	**Economic policy: Subsidies**	**Diesel with taxes**	**Pass through Diesel**	**Petrol95 with taxes**	**Pass through Petrol 95**	**Diesel without taxes**	**Δ Prices Diesel**	**Petrol95 without taxes**	**Δ Prices Petrol95**
Portugal	0.085 €/L (Diesel) 0.085 €/L (Petrol95)	-0.0907***	206.7%	-0.0573***	167.4%	-0.0185	-21.8%	0.0027	3.2%
Greece	0.15 €/L (Diesel) 0.22 €/L (Petrol95)	-0.0582**	138.8%	0.0279	87.3%	-0.0668***	18.6%	0.0076	3.5%
Spain	0.20 €/L (Diesel) 0.20 €/L (Petrol95)	0.0588***	70.6%	0.0361**	82%	0.0348***	17.4%	0.0194	9.7%

***, **, * represent 1%, 5% and 10% significance levels respectively.

In Table 4 we can see, first, the average impact on prices, and in the second term the pass-through to the final prices, or the impact of the tax reduction or subsidy implemented in the country. We do this analysis for both types of products (diesel and gasoline 95), and for prices after and before taxes. For example, in the case of Ireland estimations show that diesel prices after taxes decreased by 9.57 cents per euro, when the tax reduction was 15 cents. This means that 63.8% of the tax reduction was passed to the final prices (9.57/15). So, we calculate the pass-through like the estimated coefficient divided by the tax reduction or the subsidy.

Table 4 also shows that the countries that have introduced tax reductions produce very heterogeneous - although very similar - results, between the two types of fuel.

We can distinguish two groups of countries, those that transfer 100% of the amount and that also exceed this percentage because they present significant reductions in prices before taxes (in margins); and the countries that do not transfer 100% of the tax reductions or subsidies introduced and that present an increase in prices before taxes (an increase in margins). In the former group we find Croatia, Cyprus, France, Germany, Portugal and Greece. In these countries, the measures introduced have generated at least a decrease equal to the tax reduction or the subsidy introduced by the government. As such, pre-tax prices have either remained constant or decreased compared to the control group countries. These results show some differences from Drolsbach et al (2022), where through a difference-in-difference estimator obtain a pass-through of 100% for gasoline in France, but only around 66% in Diesel. In the case of Germany results are around 80% for gasoline and 50% for Diesel. For Italy the pass-through is near zero for both type of fuels. The difference in the results may be due to the fact that in this paper only two countries are used as a control group (Austria and Switzerland).

In the latter group we find the countries where companies are able to 'capture' a part of the tax reduction or subsidy, generating an increase in prices before taxes. In the case of Ireland, 63.8% in the case of diesel and 65% in gasoline 95 is transferred to a lower final price, while companies appropriate 15%, which is reflected in higher prices before taxes[9]. The Netherlands presents a very similar result with transfers of 63 and 78.1 percent in the case of diesel and gasoline 95, while 21.3 and 5.1 percent of the tax reduction was translated into higher prices before taxes (higher margins) for operators. In Belgium, 63.4 and 57.6 were transferred to the prices of diesel and gasoline 95, while 14.9 and 21.9 percent ended up in the hands of the companies in the form of higher prices before taxes; although in the case of diesel the estimate is not precise enough to be significant.

Finally, in the case of Spain, which implemented a subsidy of 20 cents per liter and no tax reduction, we can see how in the case of diesel, 70.6% of the subsidy was transferred to the final price that consumers ended up paying (i.e. the final price after taxes minus the subsidy of 20 cents per liter), while 17.4% (3.5 cents per liter) is appropriated by the companies in

[9] In addition to excise taxes, which are a fixed amount per liter, there are other indirect taxes that are calculated as a percentage of the price before taxes and which may cause the sum of the two percentages to not equal 100%. In any case, if we take into account the standard deviation of the estimated coefficients, all the countries in the second group have coefficients close to, or equal to, 100%.

terms of higher prices (higher margins) before taxes. In the case of 95 gasoline, 82% of the subsidy is transferred to the final prices actually paid by consumers, while approximately 10% of the subsidy ended up in the hands of the operating companies (approximately 2 cents per liter). The average of all the countries in this latter group stands at 75%, a result very similar to that obtained by Doyle Jr and Samphantharak (2008) and Ganapati et al (2020).

Independently of the pass-through, Gars et al (2022) show how the subsidies introduced by many European countries have caused an increase in Russia's income, as it is an exporter of petroleum products, of 8 million euros per day. This represents 3.1 billion euros a year, 0.2 percent of Russia's GDP and 5 percent of the country's military spending. The authors point out that a direct transfer to citizens, equivalent to the tax reduction, significantly reduces these effects.

4. Parallel trends and placebos

The basic assumption of the DiD estimator is that trends in the treated and control group are the same in the period before the external intervention. In this section, we test whether the outcome variables of interest (all four prices considered) follow parallel trends in both groups (each treated country versus the whole of the control group).

In order to test the previous hypothesis, we follow Galiani et al (2005). We estimate a model similar to equation [1] but with no constant and that includes interactions between each group and the trend variable (i.e. the fully saturated model; so we are able to test the equality of the relevant coefficients).

We performed four tests for each type of price and compared each country versus the whole of the control group. In total, 52 estimations and tests were implemented (see Table A.2, Annex 2). In all cases, the null hypothesis cannot be rejected (the treatment and control group trends are the same in the pre-treatment period). These imply that the prices of the control group before the intervention had identical trends before the exogenous change in the policies implemented. Likewise, we have included graphs in Annex 3 where it can be seen how the evolution of prices in the affected countries is very similar to the control group before the implementation of the different policies, both in the case of diesel and gasoline 95.

Moreover we perform standard placebo tests that allow us to ensure that the effects found are due to the public policy change, and not for other reasons or missing variables. The test is performed by only considering control countries. We estimate again equation [1] but in this case: i) the three different periods considered in our sample are estimated separately (March 07, 14 and 28); ii) for each period, several control countries are used as treated countries. The results are presented in Table 4 to 6 (a and b) in Annex 4. As can be seen, no DiD coefficient shows statistical significance.

5. Conclusions

The international price increases generated by Russia's invasion of Ukraine is one of the main causes of inflation, especially in Europe. Specifically, one of the energy products that most contributes to the increase in inflation are petroleum products. In order to contain inflation, many European countries have introduced tax reductions or subsidies that have been intended to reduce the final price paid by consumers.

However, there are doubts about whether these measures have been efficient and have been fully transferred to final prices or whether companies have managed to appropriate a significant percentage of them. The fact that we are in a market with very inelastic demand, together with a high concentration in the market that allows companies to have a certain market power, indicates that it would be possible for companies to increase their margins by partially appropriating the tax reduction or subsidy.

This paper analyzes the effect of these measures on the prices of diesel and gasoline 95 in European countries through a difference-in-difference estimator, using weekly data for 24 European countries from January to May, 2022. The results show a high degree of heterogeneity between countries, although on average approximately 70 percent of the tax reductions are transferred, while in the case of subsidies they are transferred completely, except for Spain, which is once again around 70 percent in the case of diesel and 80 per cent for unleaded gasoline 95. Therefore, these measures are inefficient, as only a part has an impact on the final price paid by consumers.

Additionally, these measures especially favor high-income consumers, as they have a greater number of vehicles and/or make greater use of them, which is clearly regressive. In fact, these interventions mean that consumers - especially those with above average incomes - increase their consumption compared to the scenario without public intervention. Furthermore, these changes represent a significant increase in resources for Russia (as they are oil and derivative product exporters), and go against the objective established in Europe to reduce polluting emissions.

For all these reasons, the introduction of tax reductions or consumption subsidies may not be the most efficient to mitigate the increase in energy prices at international level. A direct subsidy for lower-income consumers to compensate for the increase in energy prices might be one alternative. In any case, it is clear that further research is needed at country level in order to control for other potential factors affecting prices (local competition, other measures, etc.) and long-term effects.

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Annex 1

Table A.1. Price elasticities in European countries

	Drollas (1984)	Dahl (2012)
Austria	-0.52 (s.r) / -0.57 (l.r)	-0.54 (g) / -0.16 (d)
Belgium	-0.48 (s.r) / -0.5 (l.r)	-0.34 (g) / -0.38 (d)
Denmark	-0.31 (s.r) / -0.38 (l.r)	-0.4 (g) / -0.2 (d)
France	-0.44	-0.35 (g) / -0.24 (d)
Germany	-0.41 (s.r) / -0.53 (l.r)	-0.28 (g) / -0.38 (d)
Greece		-0.33 (g) / -0.44 (d)
Holland	-0.29	-0.34 (g) / -0.01 (d)
Ireland		-0.3 (g) / -0.38 (d)
Italy	-0.38 (s.r) / -0.41 (l.r)	-0.38 (g) / -0.24 (d)
Luxembourg		-0.33 (g) / -0.38 (d)
Malta		-0.32 (g) / -0.13 (d)
Poland		-0.32 (g) / -0.13 (d)
Portugal		-0.25 (g) / -0.29 (d)
Romania		-0.26 (g) / -0.13 (d)
Spain		-0.24 (g) / -0.38 (d)
Sweden	-0.16 (s.r) / -0.17 (l.r)	-0.32 (g) / -0.25 (d)

Source: Own elaboration. Note: s.r. short run; l.r., long run. g is gasoline 95; d is diesel.

Annex 2: Parallel trends

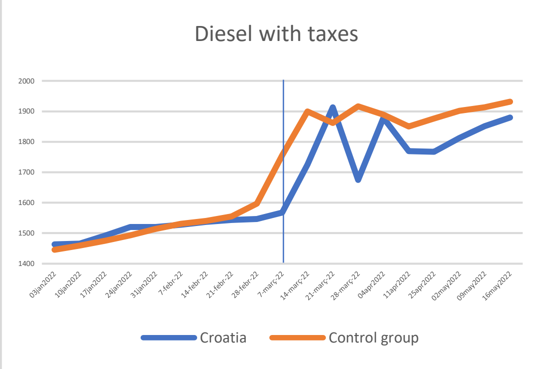
Table A.2: Parallel trends: Treated vs. Control before the policy

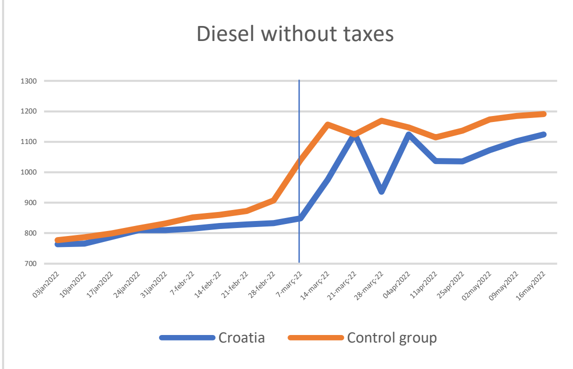
Country	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Croatia	F(1, 201)=0.16	F(1, 201)=0.68	F(1, 201)=0.35	F(1, 201)=1.38
	0.68	0.41	0.55	0.24
Cyprus	F(1, 201)=0.23	F(1, 201)=0.78	F(1, 201)=0.05	F(1, 201)=0.19
	0.63	0.38	0.83	0.66
Ireland	F(1, 201)=0.02	F(1, 201)=0.00	F(1, 201)=0.08	F(1, 201)=0.28
	0.89	0.94	0.77	0.59
Netherlands	F(1, 201)=0.57	F(1, 201)=0.62	F(1, 201)=0.10	F(1, 201)=0.23
	0.45	0.43	0.75	0.63
Portugal	F(1, 201)=0.09	F(1, 201)=0.03	F(1, 201)=0.16	F(1, 201)=0.52
	0.76	0.85	0.68	0.47
Belgium	F(1, 201)=0.02	F(1, 201)=0.24	F(1, 201)=0.08	F(1, 201)=0.44
	0.88	0.63	0.77	0.51
France	F(1, 201)=0.14	F(1, 201)=0.15	F(1, 201)=0.13	F(1, 201)=0.33
	0.71	0.70	0.72	0.56
Greece	F(1, 201)=0.02	F(1, 201)=0.00	F(1, 201)=0.01	F(1, 201)=0.00
	0.88	0.99	0.94	0.95
Italy	F(1, 201)=0.33	F(1, 201)=0.28	F(1, 201)=0.58	F(1, 201)=0.97
	0.57	0.59	0.45	0.33
Slovenia	F(1, 201)=1.93	F(1, 201)=0.93	F(1, 201)=0.25	F(1, 201)=0.18
	0.17	0.33	0.62	0.67
Germany	F(1, 201)=1.82	F(1, 201)=2.23	F(1, 201)=1.47	F(1, 201)=2.69
	0.18	0.14	0.23	0.10
Spain	F(1, 201)=0.02	F(1, 201)=0.00	F(1, 201)=0.05	F(1, 201)=0.11
	0.90	0.97	0.82	0.74
Luxembourg	F(1, 201)=0.20	F(1, 201)=0.35	F(1, 201)=0.26	F(1, 201)=0.41
	0.66	0.55	0.61	0.52

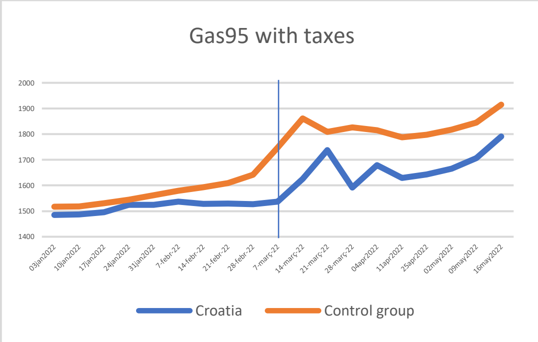
Note: the t-test is Treated country*trend vs. Control group*trend, in the period before.

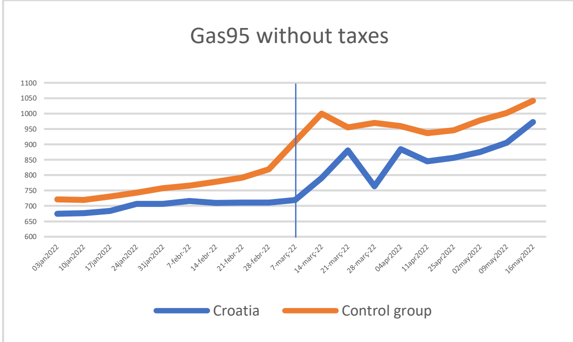
Annex 3: Graphs of parallel trends

Croatia









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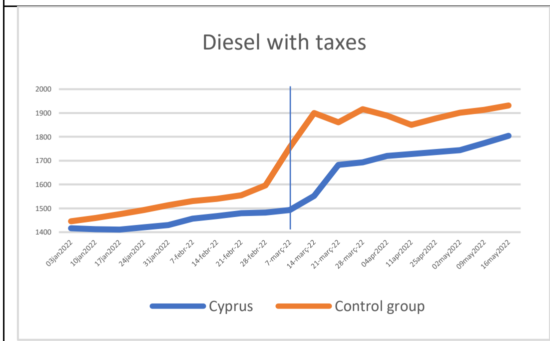
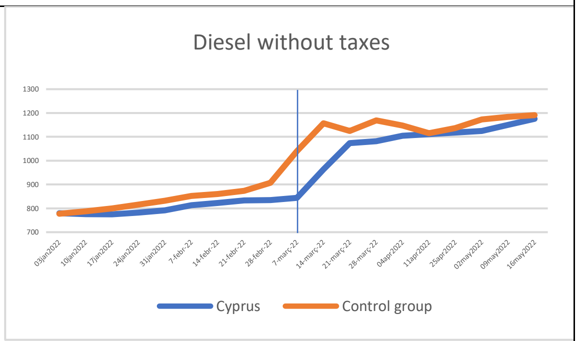
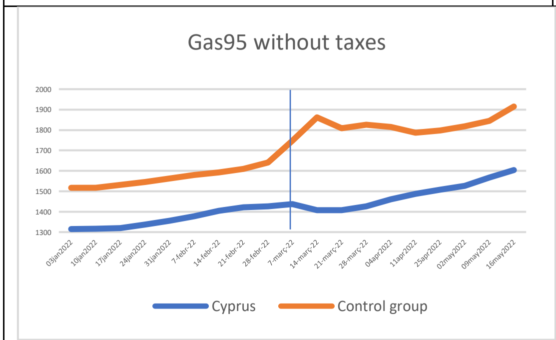
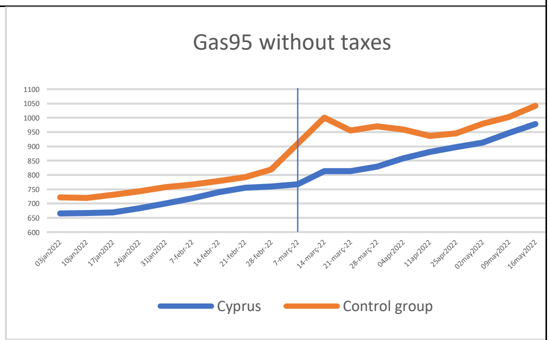
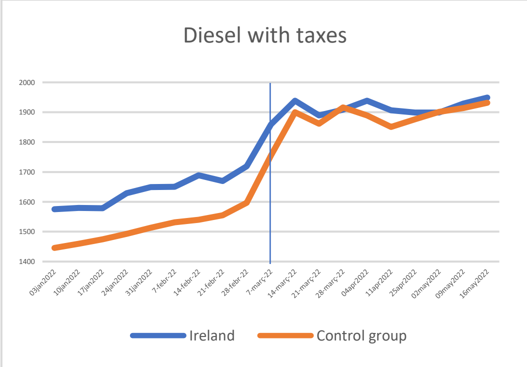


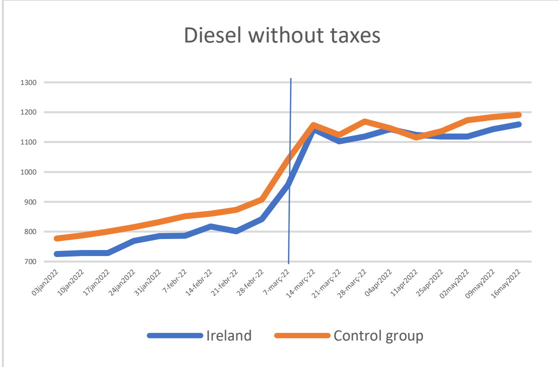


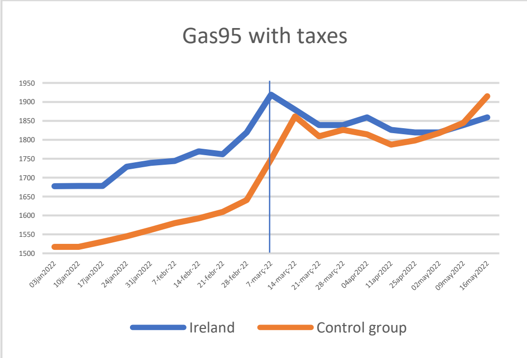


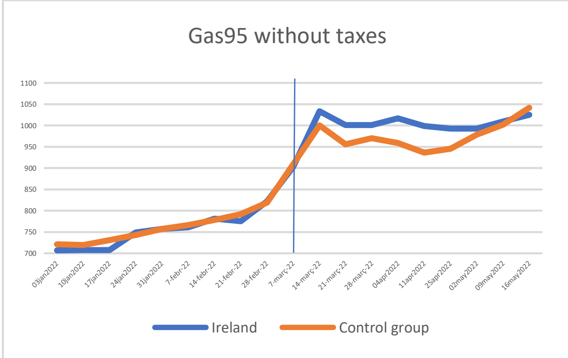


Ireland

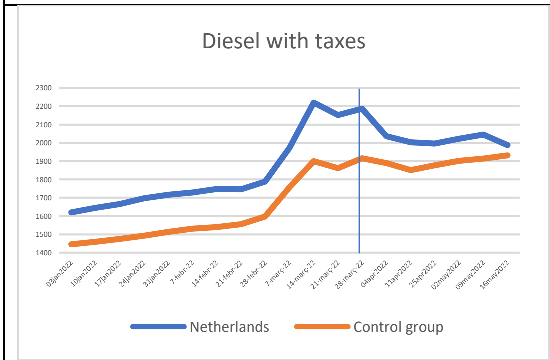


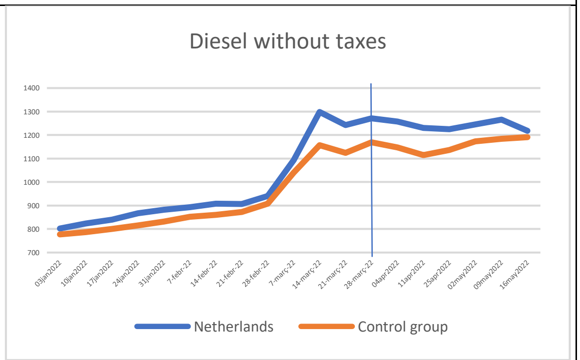


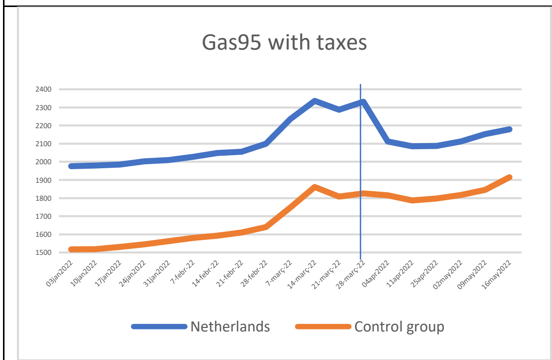


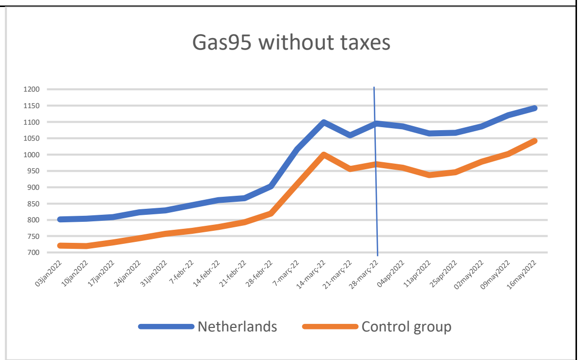


Netherlands

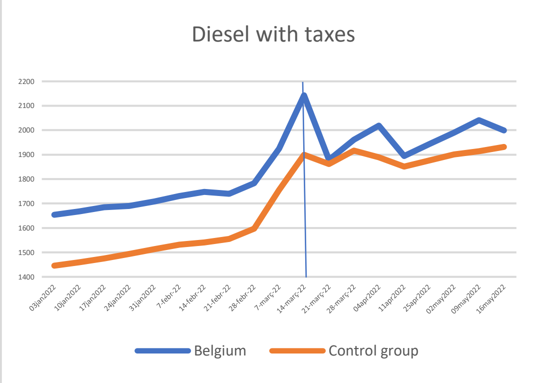


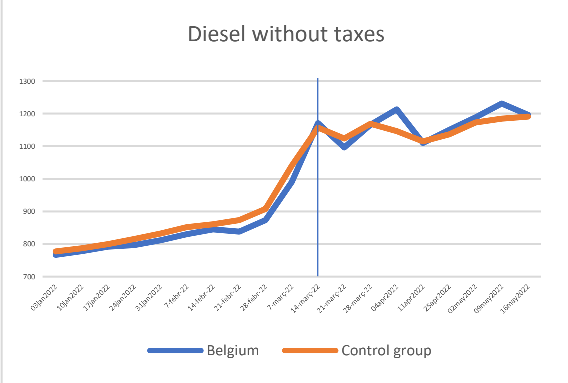


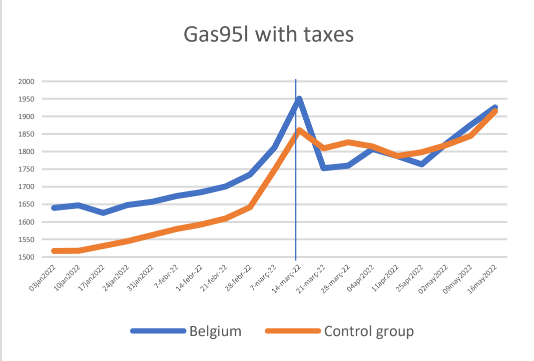


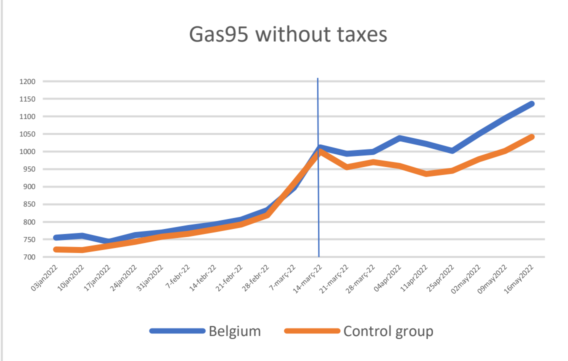


Belgium

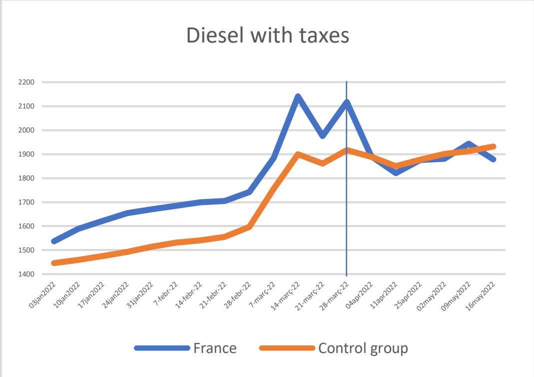


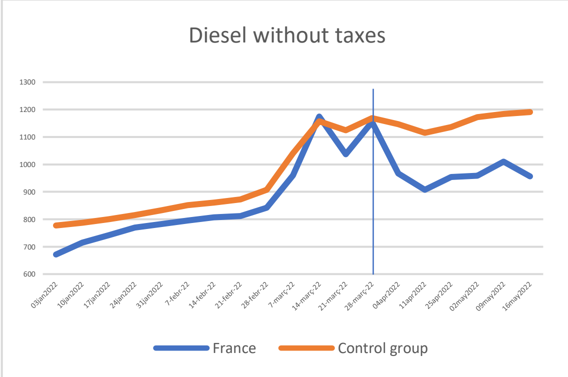


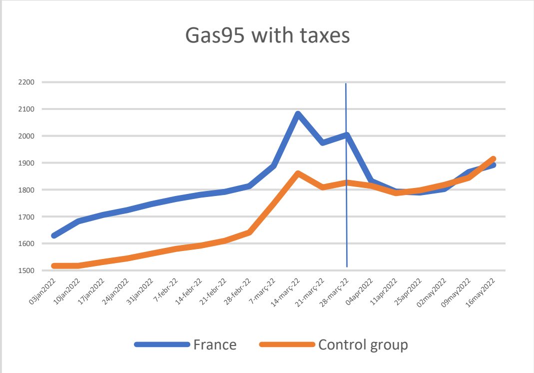


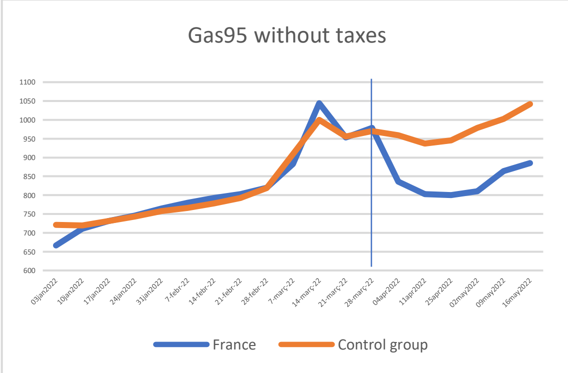


France

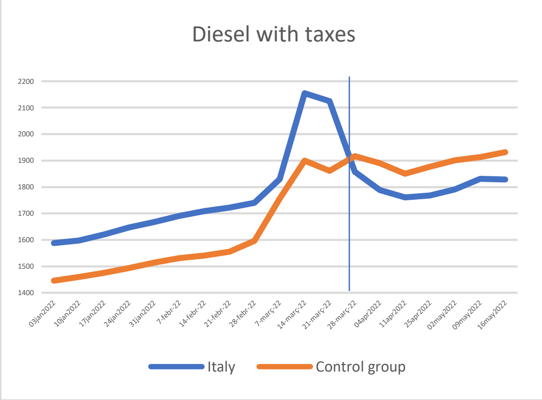


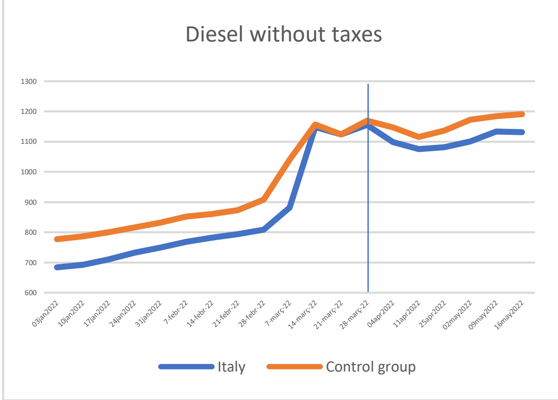


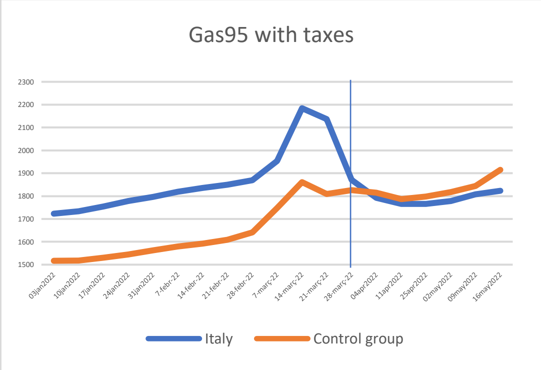


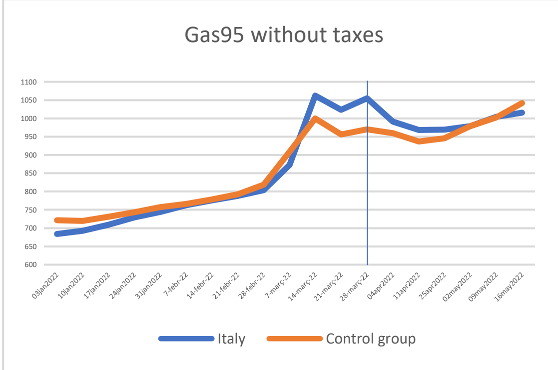


Italy

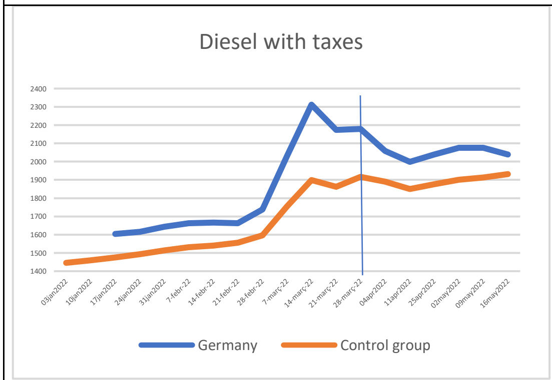


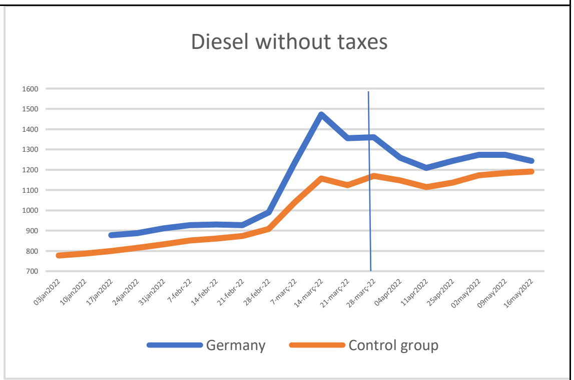


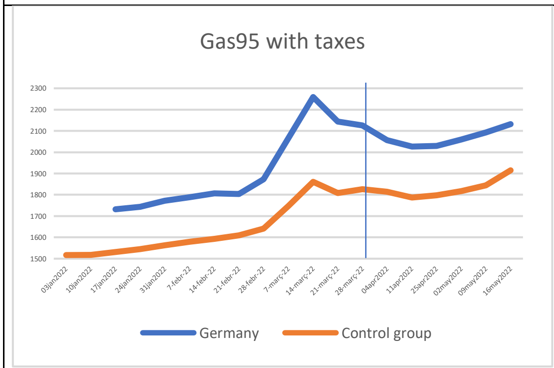




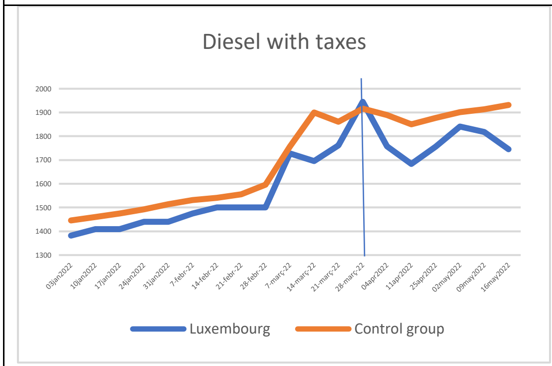
Germany

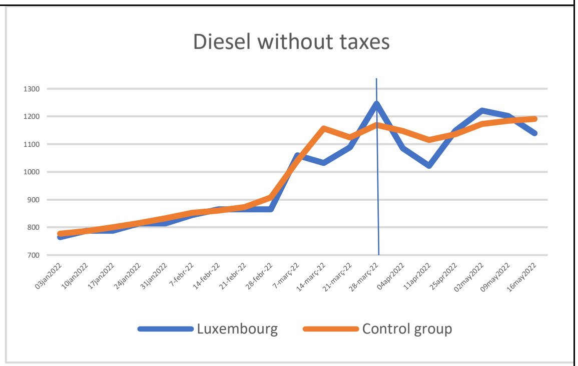


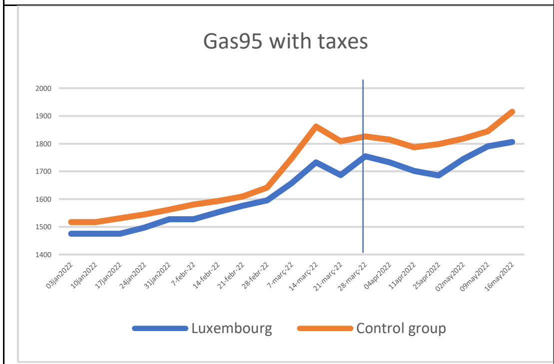


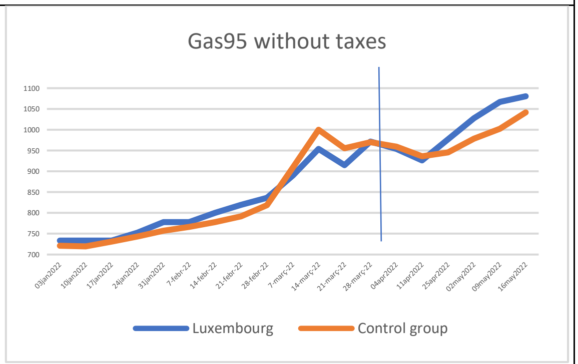


Luxembourg

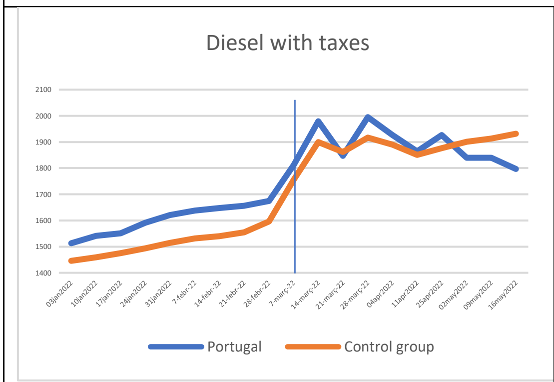


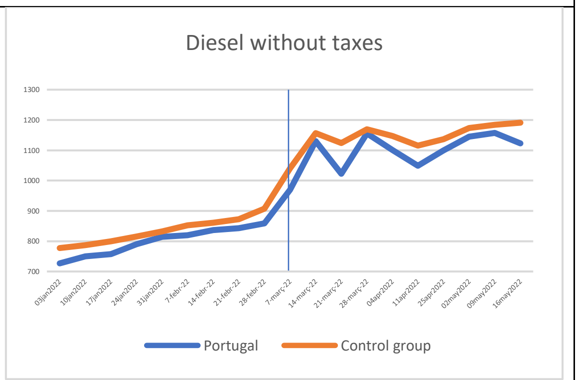


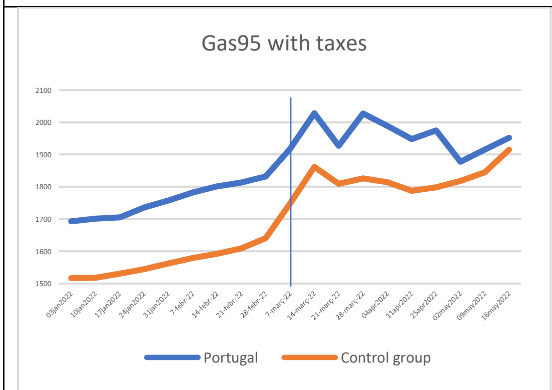


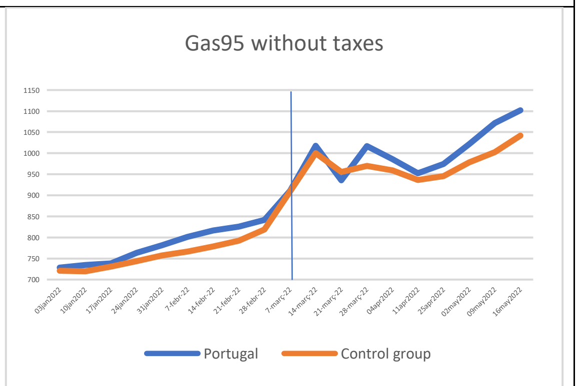


Portugal

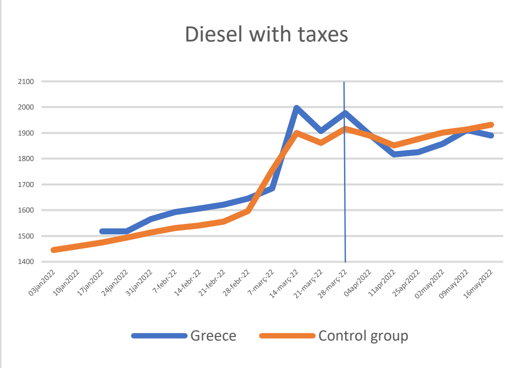


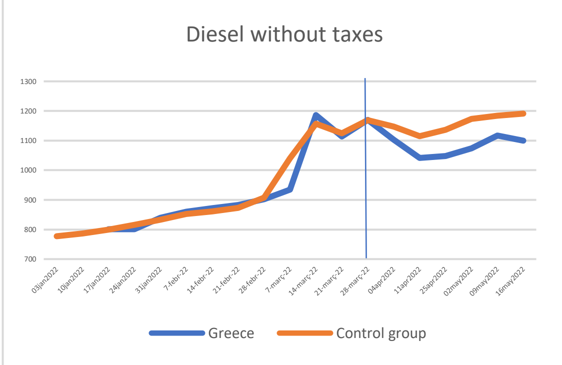


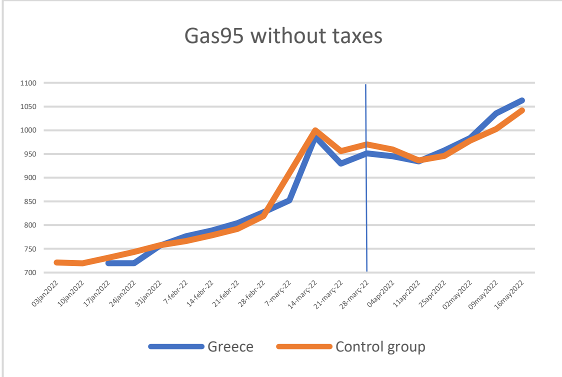




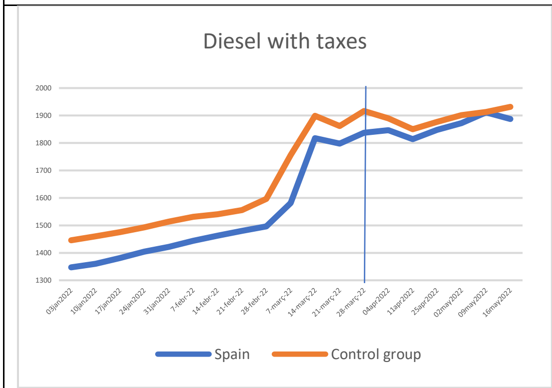
Greece

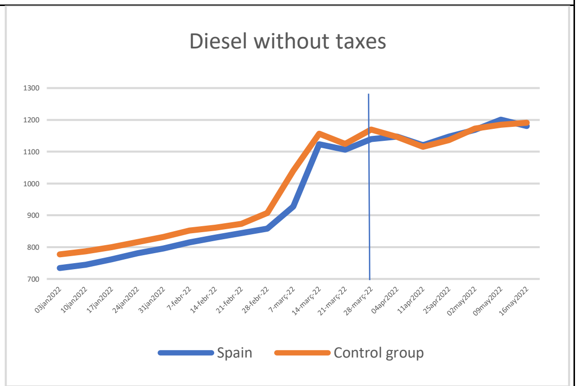






Spain





Annex 4: Placebo tests.

Table 4a: Placebo test: Denmark as treated country after March, 07. [¿?Add year here and below?]

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Denmark)	0.1614***	0.3844***	0.0515***	0.1194***
	(0.02)	(0.02)	(0.01)	(0.02)
After (March, 07)	0.2983***	0.1890***	0.2488***	0.1594***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	0.0052	0.0008	-0.0146	-0.0080
	(0.03)	(0.02)	(0.02)	(0.02)
Brent (€ per liter)	0.4928***	0.4952***	0.4627***	0.3983***
	(0.14)	(0.09)	(0.11)	(0.08)
Observations	189	189	189	189
R^2	0.95	0.96	0.93	0.89

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

Table 4b: Placebo test: Finland as treated country after March, 07.

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Finland)	0.3465***	0.4240***	0.1378***	0.0693***
	(0.02)	(0.02)	(0.01)	(0.01)
After (March, 07)	0.3034***	0.1925***	0.2524***	0.1616***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	0.0414	0.0203	0.0177	0.0094
	(0.03)	(0.02)	(0.02)	(0.02)
Brent (€ per liter)	0.4629***	0.4717***	0.4378***	0.3863***
	(0.13)	(0.09)	(0.11)	(0.07)
Observations	208	208	208	208
R^2	0.95	0.96	0.93	0.89

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

Table 5a: Placebo test: Estonia as treated country after March, 14.

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Estonia)	-0.0016	0.1400***	0.0344**	0.0429***
	(0.02)	(0.02)	(0.02)	(0.01)
After (March, 14)	0.2399***	0.1529***	0.2016***	0.1288***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	0.0111	-0.0054	0.0038	-0.0043
	(0.03)	(0.02)	(0.02)	(0.02)
Brent (€ per liter)	1.0744***	0.8641***	0.9322***	0.7047***
	(0.10)	(0.07)	(0.09)	(0.06)
Observations	189	189	189	189
R^2	0.96	0.97	0.95	0.91

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

Table 5b: Placebo test: Czech Republic as treated country after March, 14.

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Czech Republic)	0.0065	0.0241	-0.0016	-0.0228
	(0.02)	(0.02)	(0.02)	(0.02)
After (March, 14)	0.2401***	0.1528***	0.2010***	0.1279***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	0.0334	0.0232	0.0207	0.0183
	(0.03)	(0.02)	(0.03)	(0.02)
Brent (€ per liter)	1.0834***	0.8592***	0.9419***	0.7097***
	(0.10)	(0.07)	(0.09)	(0.05)
Observations	208	208	208	208
R^2	0.96	0.97	0.95	0.91

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

Table 6a: Placebo test: Slovakia as treated country after March, 28.

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Slovakia)	-0.0964***	0.0063	-0.0702**	-0.0482**
	(0.03)	(0.03)	(0.03)	(0.02)
After (March, 28)	0.1624***	0.0928***	0.1405***	0.0819***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	-0.0128	-0.0029	-0.0180	-0.0049
	(0.03)	(0.02)	(0.02)	(0.02)
Brent (€ per liter)	1.6679***	1.2737***	1.4157***	1.0373***
	(0.11)	(0.07)	(0.09)	(0.06)
Observations	189	189	189	189
R^2	0.93	0.95	0.90	0.85

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

Table 6b: Placebo test: Austria as treated country after March, 28.

	Diesel with taxes	Petrol95 with taxes	Diesel without taxes	Petrol95 without taxes
Treated (Austria)	0.2509***	0.2440***	0.1369***	0.0779**
	(0.04)	(0.04)	(0.03)	(0.03)
After (March, 28)	0.1582***	0.0927***	0.1359***	0.0807***
	(0.02)	(0.01)	(0.01)	(0.01)
Difference-in-difference	0.0125	-0.0006	0.0041	-0.0026
	(0.04)	(0.04)	(0.03)	(0.03)
Brent (€ per liter)	1.6938***	1.2812***	1.4388***	1.0514***
	(0.10)	(0.07)	(0.08)	(0.06)
Observations	208	208	208	208
R^2	0.92	0.94	0.90	0.85

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.$