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Do Cooperatives Exercise Market Power?

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Abstract

Cooperatives, formally established to enhance social welfare and local economic development, often face pressures that divert them from these foundational goals and lead to their transformation into profit-driven entities that exploit market power. Leveraging an unexpected tax change following a vote of no confidence, we examine the pass-through to retail prices as a test for market power, using data from over 250 cooperatives operating in the Spanish fuel market. Our findings reveal a complete pass-through of the tax increase, deviating from the typical pattern observed among for-profit counterparts, which usually exhibit tax under-shifting, indicative of markup adjustments and market power exertion. Further descriptive evidence highlights lower prices at cooperative gas stations relative to for-profit peers which is consistent with the absence of a markup among them. Our study challenges prevailing assumptions by illustrating cooperatives' prioritization of consumer welfare over profit maximization, thereby justifying the regulatory advantages they enjoy.

JEL Classification Numbers: D22; H22; H32; L21; L29; P13.

Keywords: Cooperatives, Pass-through to prices; Market power; Firm conduct; Retail fuel market.

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1 Introduction

Cooperatives, owned by a group of individuals (such as workers, consumers, or farmers) with shared interests, have long played a crucial role in various sectors (e.g., agriculture, food, and construction). Currently, these collective firms not only provide work opportunities to 10% of the world's labor force but also generate a turnover exceeding $2.17 trillion (ICA, 2023). By bringing together like-minded individuals who aim to advance their common goals, whether it be achieving better prices for goods or ensuring fair access to essential services, they have the potential—often formally stated in their constitution and by-laws—to enhance market outcomes and promote the socio-economic development of local communities (Novkovic, 2008; Bouchard et al., 2020; Hunter et al., 2022). However, as we delve into the dynamics of the markets in which these firms operate, Birchall (2014) highlights the risk faced by cooperatives of being captured by interest groups. Ambitious managers, in particular, may lead them to deviate from their original objectives and transform into profit-driven enterprises, potentially compromising social welfare. If this were to occur, as stated by Duarte et al. *(forthcoming)*, they would become what early leaders of the cooperative movement feared: a "degenerate" that strays from their genuine purpose.

In light of these concerns, this paper aims to address a straightforward empirical question: Do cooperatives exercise market power? This question becomes particularly intriguing when examining cooperatives that are primarily (though not exclusively) formed to sell their products to their members-owners, with the explicit aim of maximizing their *collective interests*. These cooperatives should exhibit behavior that aligns with efficient pricing as a way to internalize the consumer surplus they generate (Mikami, 2003; Dewatripont and Tirole, 2019). Conversely, the exercise of market power—which would result in a markup in their prices—may appear inconsistent with their underlying principles and nature. Furthermore, if their behavior does not significantly diverge from that of their profit-maximizing counterparts, it raises pertinent questions regarding the justification for tax exemptions (Burdin and Dean, 2009; Pencavel, 2013; Tortia et al., 2013) and other regulatory advantages—for example, antitrust (Crespi and MacDonald, 2022)—often granted to cooperatives in many jurisdictions.

To explore this question, we rely on daily price data from the universe of cooperatives operating in the retail transportation fuel market in Spain between January 2018 and June 2019 to uncover whether their pricing behavior aligns with the presence of a markup, indicating the exercise of market power. Our analysis not only provides descriptive data that merely outlines the "raw" price differences between cooperatives and for-profit gas stations. More significantly, we exploit an exogenous and unexpected change in the fuel duties following a *vote of no confidence*—resulting in an approximate 11% rise in the cost of fuel for gas stations in specific regions of Spain—to examine to what extent this tax change is passed onto cooperatives' final retail fuel prices. Given the direct connection between pass-through behavior and market power—see, for example, Weyl and Fabinger (2013), Pless and van Benthem (2019), and Genakos and Pagliero (2022)—this analysis allows us to test whether the observed price differences before and after the tax shock among cooperative-owned gas stations are consistent with a markup adjustment (which would be expected in a for-profit business), or if the pass-through rate rather reflects efficient pricing, preserving consumer (and overall) welfare.

The pass-through test is not only a parsimonious tool extensively employed to identify the presence of market power (Hong and Li, 2017; Miller et al., 2017; Pless and van Benthem, 2019);[1] its implementation in our specific empirical setting also presents some key attributes that make it particularly well suited to address the question at hand. To begin with, we focus on an industry (the retail fuel market) where exercising market power is frequently considered the norm (Deltas, 2008; Byrne and De Roos, 2019). The potential for market power is particularly apparent in the case of cooperative gas stations in our sample, as many of them are located in isolated areas, catering to rural communities with very limited or no competition. This unique positioning enables us to investigate the extent to which they exploit their status as the sole supplier, effectively exercising market power. Additionally, our sample comprises information from over 250 cooperatives—in stark contrast to previous analyses that often use data from a single cooperative or a few—thus enhancing the robustness of our findings. Furthermore, it includes diverse types of cooperatives, encompassing both agricultural cooperatives and a consumer-workers cooperative that owns multiple outlets. These cooperative forms are characterized by their mission to prioritize the well-being of their members (consumers) rather than pursuing profit maximization.[2]

Using a difference-in-differences approach, our estimates reveal an average fuel price increase of

[1] Muehlegger and Sweeney (2022) provide an overview of the various applications of pass-through in the literature, covering areas such as the incidence of taxes, distributional impacts of trade tariffs, and the recovery of demand elasticities.

[2] In Spain, a formal association of all agricultural cooperatives engaged in fuel sales (called *Cooperativas Agro-alimentarias*) explicitly declares its commitment to providing an essential service in rural areas where the cooperatives operate and to maintaining competitive prices to the benefit of all the residents in the rural areas served (see Section 2.2 for further details).

€ 0.056-0.059 per liter among gas stations owned by cooperatives in the five states of Spain affected by the tax change, indicating a pass-through rate of about 100%. This finding remains consistent across different model specifications, sample selections, and robustness checks for both unleaded gasoline and diesel fuels, providing compelling evidence of the absence of a markup adjustment. This result stands in stark contrast with the 72% pass-through rate identified by Bajo-Buenestado and Borrella-Mas (2022) among for-profit (independent) gas stations in the same context (implying the presence of a markup adjustment)[3] and also with the findings by Genakos and Pagliero (2022), who examine a similar context with Greek data and demonstrate that isolated (for-profit) retail gas stations exhibit a tax pass-through rate of about 40% (which increases only under more intense competition). In our case, even when considering only the subsample of cooperative-owned gas stations in rural areas with no competition, these gas stations still consistently display a 100% pass-through rate. Finally, our "absence-of-markup result" is further supported by descriptive data, revealing that cooperatives consistently offer prices of approximately 6 cents per liter lower than non-cooperatives throughout the entire sample period.

Our paper contributes to the literature that empirically investigates the market behavior of cooperatives. This body of research is rooted in theoretical foundations summarized by Bonin et al. (1993) and Soboh et al. (2009). Building on this theoretical work, prior scholars tested whether the organizational conduct of cooperatives aligns with the diverse objectives outlined in their constitutions and by-laws. Notable examples include studies on dividend and employment maximization within worker cooperatives (Craig and Pencavel, 1993; Pencavel and Craig, 1994) and cost minimization (Clymer et al., 2021). While these studies predominantly focus on internal organizational dynamics, a gap persists in understanding the "external" (i.e., market) behavior of cooperatives—a dimension that underpins the policy benefits they receive. Addressing this gap is the main objective of our study.[4]

In this context, the closest work to ours is by Duarte et al. *(forthcoming)*, focusing on the market behavior of Coop Italia—the largest Italian consumer cooperative in the grocery sector. Their empirical analysis, grounded in granular data obtained from this cooperative and other (for-profit) competi-

[3] According to Bajo-Buenestado and Borrella-Mas (2022), the markup adjustment vanishes among gas stations that are vertically integrated with a refiner. It is noteworthy that none of the cooperative gas stations in our sample are vertically integrated. As explained in Section 2.1, both cooperative-owned and for-profit non-vertically integrated gas stations have identical contractual arrangements with refiners, namely, linear contracts.

[4] As highlighted by Agbo et al. (2015) (and as we also explain in Section 3), various types of cooperatives, such as worker cooperatives, agricultural cooperatives, and consumer cooperatives, may have distinct internal and external objectives.

tors, reveals no evidence of its behavior deviating from profit-maximizing objectives.[5] In contrast to this single-firm-focused approach, our research adopts a broader, industry-level analysis. Leveraging firm-level data from over 250 cooperatives in a market environment acknowledged for its imperfect competition, we employ the pass-through test—a widely applied tool in the literature (Loy et al., 2016; Duso and Szücs, 2017; Pless and van Benthem, 2019)—to empirically evaluate competitive pricing behavior or the lack thereof. Moreover, our focus on a homogeneous commodity, namely, transportation fuel, allows us to abstract from discrepancies in the quality of goods and services between cooperatives and other business models (Boylan, 2016). In contrast to the findings by Duarte et al. *(forthcoming)*, our study shows no evidence of market power exertion and profit maximization among cooperatives in our context. This result suggests that, when regulating cooperatives, policymakers should shift from one-size-fits-all approaches and consider tailored policies, evaluating subgroups of cooperatives in different industries individually.

Finally, our study contributes to a broader literature that examines the behavior of not-for-profit and prosocial firms (Philipson and Posner, 2009; Fioretti, 2022; Eggleston, 2024; Ericson, 2024). Within this literature, a significant focus has been put on the healthcare industry. Previous works in this domain, including studies by Duggan (2002), Silverman and Skinner (2004), Dormont and Milcent (2005), and Capps et al. (2020), have often found minimal disparities in the conduct of not-for-profit hospitals compared to their for-profit counterparts. In contrast, our findings align with the observations of Lynk (1995), highlighting that not-for-profit hospitals frequently offer lower prices than their for-profit counterparts (particularly in highly concentrated market environments) and with the results by Dafny (2019), who noted a significant increase in premiums when a not-for-profit health insurer transitioned to a for-profit status.

The rest of the paper proceeds as follows. Section 2 provides background information on the fuel market in Spain, the role of cooperatives, and an overview of the fuel tax reform under consideration. Section 3 briefly discusses theoretical predictions on pass-through under different firm objectives. In Section 4, we present the data and empirical strategy to identify the causal impact of the tax on cooperative prices. Section 5 presents empirical results and robustness checks. Finally, Section 6 concludes and provides some policy recommendations.

[5] In the same vein, employing aggregated market data from the US dairy market, Cakir and Balagtas (2012) revealed compelling evidence of market power exertion wielded by cooperatives.

2 Institutional background

2.1 The Spanish transportation fuel market

In Spain, the transportation fuel market presents two main characteristics commonly observed in many other countries. To begin with, it features diverse vertical relationships between refiners and gas stations (Hastings, 2004; Houde, 2012). These relationships can be broadly classified into two categories that give rise to two main types of gas stations: vertically integrated gas stations, which are owned and managed by refiners, and independent ones, owned and operated by retailers (i.e., entrepreneurs). The latter sign contracts with a refiner for fuel supply. As explained by Manuszak (2010), these fuel supply contracts are predominantly *linear*; that is, the retailers are charged a price per unit of fuel—which, in the case of Spain, is frequently the Genoa (CIF MED) wholesale price—plus a markup.

Second, the market exhibits a high level of imperfect competition. Market concentration is particularly pronounced in the wholesale segment, with three companies (namely, Repsol, Cepsa, and BP) owning all nine oil refineries in Spain and holding majority stakes in the national pipeline distribution network (Stolper, 2018).[6] Concentration is also evident in the retail segment. In 1998, the aforementioned three major oil firms controlled approximately 82% of the gas stations through vertical restraints. However, the implementation of liberalization policies in the late 1990s opened the retail segment, enabling new independent firms to enter the market. By 2009, the percentage of gas stations they controlled decreased to 70% and further declined to 61% by 2018 (Contín-Pilart et al., 2009; Stolper, 2018). Currently, a significant number of independent gas stations cater to consumers along with these three major oil companies in the retail segment.

2.2 Cooperatives in the Spanish retail fuel market

Among the vertically independent gas stations currently operating in Spain, a subset are owned and operated by different types of cooperatives.[7] Specifically, most of these gas stations are owned by *agricultural cooperatives*. This is not surprising, given the substantial presence and significance of cooperatives within Spain's primary sector, which account for over 65% of the total output of this sector and

[6] The fuel transportation and distribution from refineries to gas stations are overseen by a regulated monopolist (Exolum).

[7] Gas stations owned and operated by cooperatives are present in many other countries, such as in the UK (Birchall, 2014), the US (Wilson et al., 2011), Brazil (Martins and Lucato, 2018), and South Korea (Ahlin et al., 2021).

provide employment opportunities to over 1.1 million individuals (CEPES, 2021, 2020). The presence of these gas stations owned by agricultural cooperatives traces back to the 1980s. According to the Spanish Organization of Agricultural Cooperatives (in Spanish, *Cooperativas Agro-alimentarias*),[8] they were established with the aim of offering members of the cooperatives access to more affordable fuel (primarily diesel) in rural areas that lacked the presence of major gas companies.

The liberalization of the fuel sector facilitated the entry of additional gas stations owned by agricultural cooperatives into the retail segment, which are allowed to extend their supply beyond their members—enabling them to serve the general public. As of 2020, there were over 250 gas stations owned by agricultural cooperatives in Spain. These cooperatives, as explained by *Cooperativas Agro-alimentarias*, play a crucial role in providing an *essential service* in the rural areas where they operate, ensuring the availability of fuel for all residents. Furthermore, according to the information provided by this organization, they are committed to maintaining "competitive prices", benefiting not only their cooperative members but also third parties (including residents in the rural areas where their operations are based) who purchase fuel from these gas stations.

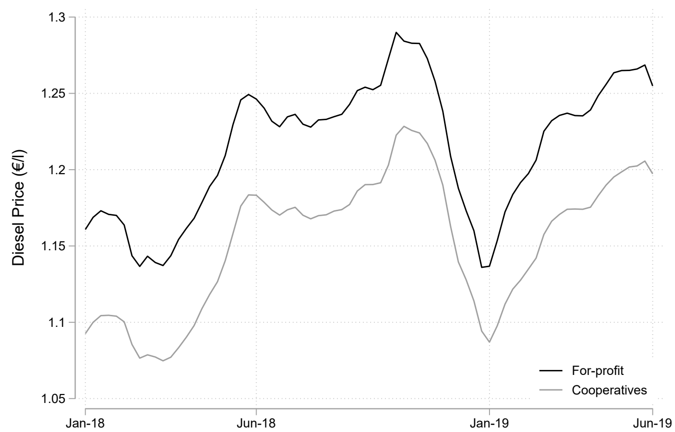
In addition to the gas stations owned by agricultural cooperatives, we also consider those owned by Eroski, a prominent *worker-consumer hybrid cooperative*, whose governance is shared between these two groups (Birchall, 2014; Roche et al., 2023). Eroski belongs to the renowned Mondragon Group (Bonin et al., 1993), known for its strong emphasis on *social impact* (particularly on its worker- and consumer-owners) as a primary goal, as explained by Morlà-Folch et al. (2021). By leveraging its extensive presence across the country—it owns a widespread retail network, including numerous supermarkets and other businesses (e.g., travel agencies, insurance, etc.)—Eroski has successfully expanded into the transportation fuel market. As a result, it has established its own brand of gas stations, managing over 50 outlets across the country.

In line with the objective of focusing on social impact and a commitment to maintaining competitive prices for the benefit of owners and consumers, Figure 1 illustrates the difference in the evolution of retail diesel prices (the predominant transportation fuel in Spain) at cooperatives and for-profit gas stations from January 2018 to June 2019. The figures reveal a consistent 6-7 euro cents lower price for

[8] *Cooperativas Agro-alimentarias* serves as the representative organization for agricultural cooperatives, advocating for their interests before national and European institutions, associations in the agriculture and the food sector, and various social-economic domains. Further information about it can be found on its website (https://www.agro-alimentarias.coop/).

diesel at cooperative-owned gas stations compared to their for-profit counterparts; a similar difference is observed for unleaded gasoline prices (see Figure A.1 in Appendix A.1). This difference observed in the raw data coincides with the estimated gas station markup suggested by the CNMC (2017) and provides initial descriptive evidence supporting the absence of any pricing markup among cooperatives.[9]

Figure 1. Average weekly diesel price of cooperative and for-profit gas stations



Note: The figure displays the average weekly retail price (in euros per liter) of diesel from the first week of 2018 to the first week of June 2019. The solid dark gray line represents the average price for for-profit gas stations, while the solid light gray line represents the average price for cooperative gas stations. The dataset was obtained from *Geoportal* (Spanish Ministry for the Ecological Transition). Section 4.1 explains the methodology used to identify the cooperative gas stations in this dataset. A similar figure for retail gasoline prices is provided in Appendix A.1 (see Figure A.1).

2.3 The 2019 gas tax reform

Petroleum-derived transportation fuels are heavily taxed in Spain, as is the case in many other countries in the European Union (EU). According to the Gasoline Bulletin EU, about half of the retail price of unleaded gasoline and diesel (the most commonly used fuels) are taxes. These taxes are imposed at two different administrative levels. First, the Spanish central government collects the national excise fuel tax, which is currently €0.4246 per liter for unleaded gasoline, and €0.331 per liter for diesel. The central government also imposes a value-added tax (VAT) of 21%, which is applied to both the excise duties and the retail price of fuels. Second, each of the 17 regional states (in Spanish, *Comunidades Autónomas*) are allowed to implement an excise fuel tax. Until 2018, states could choose a rate anywhere between 0 and 4.8 cents per liter. However, these state tax rates were also subject to the VAT, resulting in a maximum tax-inclusive rate of 5.808 cents per liter. States typically imposed either no tax or the full rate

[9]More precisely, according to CNMC (2017), gas station markups for diesel and unleaded gasoline were approximately 6-6.5 cents in 2019, which later increased to about 7 cents in 2020.

permitted,[10] which resulted in significant heterogeneity in the (tax-inclusive) fuel prices across Spain.

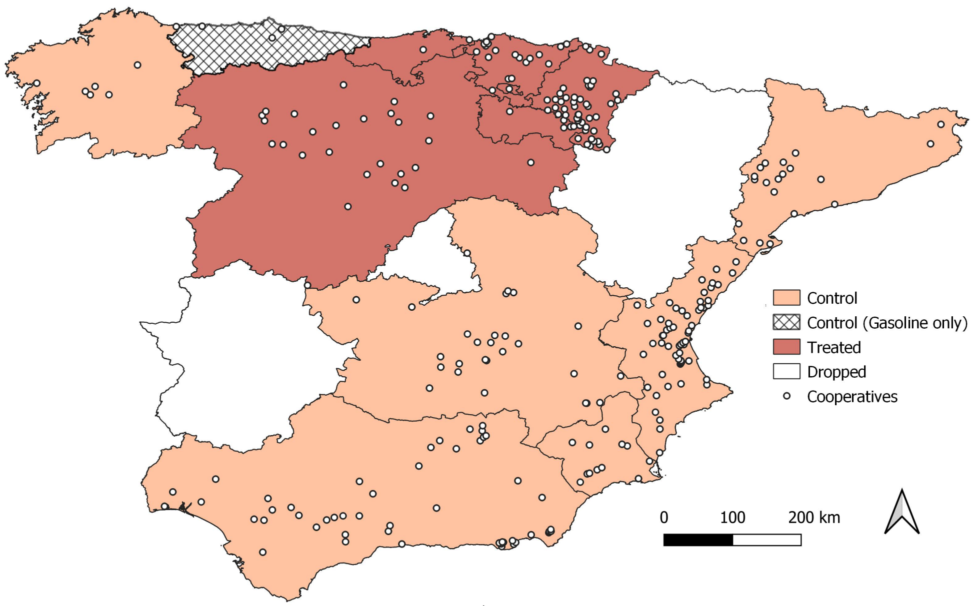
This heterogeneity in fuel taxes was unexpectedly brought to an end due to a fiscal reform implemented by the newly formed national government in June 2018. Prior to this reform, the central government had been controlled by the right-wing party, led by then-prime minister Mr. Rajoy. However, in June 2018, Mr. Rajoy's government was removed as a result of a successful *vote of no confidence* against him, which was filed by the leader of the left-wing party, Mr. Sánchez. This vote of no confidence was based on the court ruling that Mr. Rajoy's party was allegedly involved in a system of institutional corruption that manipulated public tenders. Despite lacking a majority in the congress, Mr. Sanchez negotiated and obtained the support of 180 deputies from a wide spectrum of parties—a national far-left party, two right-conservative pro-independence parties, two far-left pro-independence parties, and two center-left regionalist parties. By contrast, only 169 deputies voted for the incumbent candidate. As per the Spanish Constitution, Mr. Rajoy resigned and Mr. Sanchez was appointed prime minister.

In July 2018, the newly formed left-wing government approved the Spanish national budget, which included a reform of fuel duties with the aim of harmonizing the state rate.[11] In particular, this reform mandated the implementation of a unified excise duty rate for regular diesel and unleaded gasoline across all states, set at the maximum permissible level of 5.808 cents per liter, effective from January 1, 2019. As a result, all states that previously had a 0 rate experienced an abrupt increase of 5-6% in the prices of these fuels (an increase in the cost of fuel of approximately 11%). Specifically, this was the case in the five states labeled as the "treated" and shown in darker orange on the map in Figure 2. By contrast, the tax rate remained unchanged in the other six states, referred to as the "control" states, which are shaded in lighter orange on the same map. In the state of Asturias (indicated by grid lines), the tax rate remained steady exclusively for unleaded gasoline, with a minor uptick in diesel duties. Consequently, we employ this state as a control exclusively for analyzing gasoline prices. All cooperative-owned gas stations in our sample across these states are marked by white dots. Finally, three other states—indicated in white on the map—experienced only marginal tax rate changes and,

[10] There are four exceptions to this general pattern, namely, the states of Aragón, Asturias, Extremadura, and Madrid, which applied either an intermediate tax rate or different rates for different fuels. Additional details are provided below.

[11] Although the reform was passed by the unexpectedly newly formed left-wing government, the previous government had already contemplated a similar reform in its preliminary bill of the Spanish national budget released in April 2018. Despite receiving relatively little attention (this possibility was mentioned only in the preamble of the bill), we include in Appendix B.2 our main set of results, controlling also for a potential anticipation effect from the last week of April until June 2018, as a robustness check.

Figure 2. Cooperative gas stations (and states) used in the empirical analysis



Note: The figure displays a map of mainland Spanish states. The darker orange shading indicates the states where the fuel tax increased by 5.808 cents per liter in January 2019 (treated group). The lighter orange shading represents the states where the fuel tax remained unchanged (control group). In the state of Asturias (marked by grid lines), the fuel tax remained unchanged only for unleaded gasoline and is thus included in the control group solely for the analysis of the prices of this fuel. Each white dot represents a cooperative-owned gas station located in both subsets of states. The states not included in our empirical analysis, which experienced only a partial change in the fuel tax, are represented in white. The analysis also excludes the overseas states (not shown in the map), which have distinct tax regimes.

thus, are not included in the baseline empirical analysis, with a similar exclusion applied to Asturias in the context of diesel prices.[12] We also exclude the overseas states, which have distinct tax regimes.

3 Prices and tax pass-through under different firm objectives

Firm pricing behavior and the extent to which various shocks (such as an abrupt change in a tax) are transmitted into final prices in the presence of market power have been extensively studied and are well understood (Bulow and Pfleiderer, 1983; Seade, 1985; Weyl and Fabinger, 2013). In this section, we present a concise overview of these classical findings, focusing on the variations that arise when a firm pursues different objectives. In doing so, and consistent with our empirical setting, we assume that the

[12]The analysis of the impact on fuel prices for these states is relegated to Appendix B.5.

firm faces a constant marginal cost imposed by an upstream firm,[13] and is levied a tax per unit sold.

We start by considering the paradigmatic case in which a firm that exercises market power seeks to maximize its profits. In this case, the optimal price (P_1 in Figure 3, Panel A) is determined by the intersection of the firm's marginal revenue (MR) and marginal cost (MC), resulting in a positive markup.[14] Hence, an increase in the per-unit tax levied on the firm (denoted by τ) raises its costs and, in turn, its price. However, due to the presence of the markup, the tax increase is not fully passed on to the final consumers. Instead, the firm absorbs a portion of the tax through its markup, resulting in a pass-through rate of less than 100%. This prediction is illustrated in Figure 3, Panel B, which shows that the increase in the price (ΔP) is lower than the tax increase (τ). This theoretical insight has been extensively tested in various sectors among for-profit firms with market power—for example, Duso and Szücs (2017); Miravete et al. (2018); Ganapati et al. (2020); Wang et al. (2022).[15]

Next, we consider the scenario—often discussed in the cooperatives literature—where the firm aims to maximize the combined benefits for consumers and the producer. This objective arises, for example, if the firm frequently supplies to its members (e.g., agricultural cooperatives) and also when it seeks to maximize consumer welfare (e.g., consumer cooperatives)—see Bonin et al. (1993) and Royer (2014). Under this objective, the firm optimally sets prices at marginal cost, eliminating the price markup and resulting in a lower final price relative to its profit-maximizing counterpart (P_2 in Figure 3, Panel A). Moreover, since an increase in the per-unit tax directly raises the firm's marginal costs, the tax increase is fully passed on to the consumers. This outcome is depicted in Figure 3, Panel C, which illustrates that the price increase (ΔP) is proportional to the tax increase.

An alternative scenario also frequently considered in the cooperatives literature is that where the firm's objective is to maximize total output (Coelli and Rao, 2005; Martínez-Victoria et al., 2017; Royer, 2014). Under this objective, the optimal solution occurs when the price is set equal to the average total cost (ATC). Given the constant nature of the marginal cost,[16] this alternative case yields the same solu-

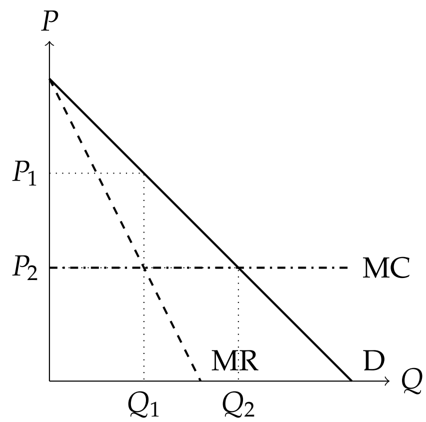
[13]In Appendix A.3, we extend our analysis to the more general case where the marginal cost is not assumed to be constant and demonstrate that our main theoretical predictions and conclusions derived under the assumption of constant marginal cost also hold in this alternative context.

[14]This applies similarly to the upstream supplier, which also sets the price above marginal cost, leading to an additional markup and giving rise to the *double marginalization* problem (Spengler, 1950; Williamson, 1971).

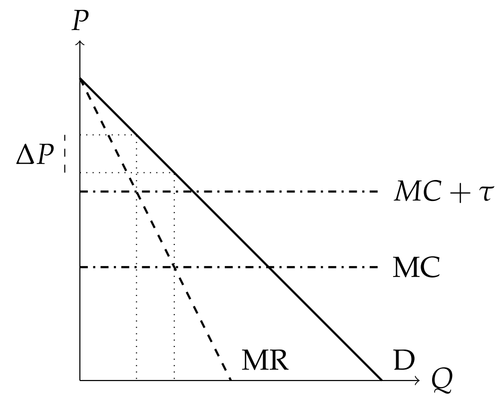
[15]In a very similar context to ours, Genakos and Pagliero (2022) and Dimitrakopoulou et al. (2023) provide evidence that gas stations with market power achieve an average pass-through rate of approximately 40-50% in response to tax changes. Note that their analyses focus on for-profit gas stations and do not include independent gas stations that are cooperative-owned.

[16]The interested reader can refer to Appendix A.3, where we discuss the more general case in which the marginal cost is not constant, resulting in an upward-slopping ATC curve.

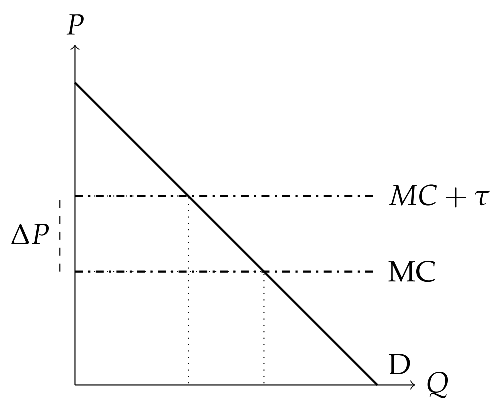
Figure 3. Firm pricing behaviour and tax pass-through under different firm objectives



(A) Firm optimal solutions under different objectives



(B) Tax pass-through for a profit-maximizing firm



(C) Tax pass-through for a surplus- or output-maximizing firm

Note: The figure illustrates the optimal solution achieved by a firm under different objectives (Panel A), and the effect of a tax (τ) increase on the price for each of the objectives considered (Panels B and C), given the demand (D) and the corresponding marginal revenue (MR) and the marginal cost (MC). In Panel A, the price and quantity pairs chosen by a profit-maximizing firm (P_1, Q_1) and surplus- or output-maximizing (P_2, Q_2) are depicted, representing the intersections of MR-MC and D-MC, respectively. Panel B demonstrates the impact of the tax increase on the price of a profit-maximizing firm. Due to the existence of a price markup, the tax is not fully passed through to the price. Panel C shows the impact of the tax increase on the price of a surplus-maximizing (or output-maximizing) firm. In this case, the firm fully passes through the tax to the price.

tion as the one included in Figure 3, Panel C. As a consequence, an increase in the per-unit tax uniformly raises the firm's cost, leading once again to a full pass-through of the tax increase into the final price.

Finally, it is important to note that if the firm operates in a perfectly competitive market, the profit maximization solution aligns with the case of maximizing total surplus (Ganapati et al., 2020). Under perfect competition, the firm is a price-taker, receiving a constant price equal to the marginal cost (regardless of the quantity sold). Consequently, the optimal solution remains the same as in the previous paragraph, resulting in the tax being fully passed on to consumers. However, since transportation retail fuel markets are typically acknowledged as imperfectly competitive—due to factors such as limited alternatives (Havranek et al., 2012; Duso and Szücs, 2017) or regulated location (Bajo-Buenestado, 2021)—assuming that our empirical results below arise due to perfect competition seems implausible. Still, to address this potential concern, we present robustness checks in our analysis by considering isolated gas stations that face no competition in local markets. Assuming that this subset of gas stations operates in an environment of perfect competition seems even more far-fetched.

4 Data and empirical strategy

This section presents the data first and then the empirical strategy that we use to identify the causal impact of the 2019 fiscal reform on cooperative gas station pricing conduct.

4.1 Data

To examine the impact of the gas tax change on fuel prices at cooperative gas stations in the states affected by the fiscal reform, we rely on data from *Geoportal*, a website managed by the Spanish Ministry for the Ecological Transition. This website provides daily spreadsheets containing retail prices of diesel, unleaded gasoline, and other fuels, as well as related information (such as the geo-localization, zip code, town, brand, and opening hours) for all gas stations in Spain. Our dataset has approximately 10,300 gas stations, with around 3% being cooperatives. To identify them, we employ two criteria. Namely, we search for keywords such as "coop" (and its variations) in their names or brands, and we also look for recognizable cooperative brands (e.g., Eroski, AN, etc.). Gas stations in states that experienced a tax change in January 2019 are classified as "treated" while the "control" ones are those in states where the fuel tax remained unchanged. Our dataset covers daily data for all these gas stations from January 2018 to June 2019 (i.e., six months before the tax announcement and six months after the tax change), which we aggregate at the weekly level.

We complement the gas station-level data with additional information on the wholesale cost of fuel for the retailers. Specifically, we use daily data on the Europe Brent Spot Price (FOB), which serves as a reference price for petroleum products in Spain. This information, obtained from the U.S. Energy Information Administration (EIA), is given in dollars per barrel and converted to euros per barrel using the euro/dollar exchange rate provided by the Federal Reserve Bank of St. Louis.[17]

Table 1. Summary statistics for different fuel prices, gas stations, and brands

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Before (Jan´18-Dic´18)			After (Jan´19-Jun´19)				
	Control	Treated	Obs.	Control	Treated	Obs.	Diff	p-v
Panel A. Prices								
Diesel (€/l)	1.16	1.13	12,897	1.16	1.18	5,328	0.0595	0.000
Gasoline (unleaded) (€/l)	1.26	1.21	9,533	1.22	1.24	4,011	0.0647	0.000
Diesel (nonroad) (€/l)	0.798	0.788	9,393	0.801	0.796	3,877	0.0047	0.037
	Before (Jan´18-Dic´18)			After (Jan´19-Jun´19)				
	Control	Treated	Obs.	Control	Treated	Obs.	Diff	p-v
Panel B. Gas Stations								
Open 24/7 (%)	54.20	77.60	276	55.00	78.30	270	-0.100	0.908
Types of fuels sold (#)	2.63	2.21	276	2.65	2.22	270	-0.006	0.867
Competitors in 2 km radius (#)	2.58	1.82	276	2.60	1.79	270	-0.044	0.926
Number of gas stations (#)	174	102		168	102			
	Gas station			Diesel		Gasoline		
Panel C. Brands	All	Control	Treated	Mean	Obs.	Mean	Obs.	
Eroski	50	24	26	1.15	3,282	1.23	3,430	
AN Energéticos	39	0	39	1.15	2,836	1.22	2,132	
Coops with $\geq$ 2 gas stations	34	26	8	1.16	2,133	1.25	1,515	
Coops with 1 gas station	157	126	31	1.16	9,974	1.25	6,470	
All	280	176	104	1.16	18,225	1.24	13,544	

Note: Panel A presents summary statistics of the average weekly retail fuel prices during both the pre-reform period (January-December 2018) and the post-reform period (January-June 2019). In Column (7), we present a "raw" difference-in-differences of means, calculated as [(After - Before) - (Treated - Control)] based on Columns (5), (4), (2), and (1), respectively. Additionally, Column (8) reports the p-value derived from a two-sided test under the null hypothesis of no difference in means. Panel B displays summary statistics of some key characteristics of the gas stations included in our sample. Panel C shows the average weekly retail diesel and gasoline prices spanning the entire duration covered by our sample, but grouped by brand/size. In the post-period, ten gas stations shut down (they no longer report prices), and four gas stations opened and started to report prices.

Table 1 (Panel A) provides summary statistics for the retail prices of diesel and unleaded gasoline, which are used in our main empirical analysis. We provide the mean of the prices for both treated and control gas stations before and after the tax reform. Column (7) displays the price differences between the two subsets of gas stations after the tax reform, with column (8) reporting the p-value for testing the null hypothesis of zero difference, which we reject for both fuels. We also include summary statistics for nonroad diesel—a fuel that contains additives that are specific for use in tractors and agricultural engines—which was unaffected by the tax reform and, hence, that we use for a placebo-based falsifica-

[17]The Brent crude oil prices closely track the behavior of the Genoa (CIF MED) prices, which serve as the reference wholesale price commonly used by Spanish refineries (Balaguer and Ripollés, 2016; Bajo-Buenestado, 2021). As such, the Brent crude oil prices effectively capture fluctuations in refinery input costs (Deltas and Polemis, 2020).

tion test. In this case, we fail to reject the null hypothesis at the 1% level of confidence. Then, Panel B of the same table presents summary statistics for key characteristics of the gas stations, such as opening hours, number of fuels sold, and number of competitors within a 2-kilometer radius. Finally, Panel C provides information on the distribution of gas stations across brands, where Eroski and AN Energéticos account for approximately one-third of the ownership, while the remaining brands represent relatively small cooperatives.

4.2 Regression model

The ideal setting to estimate the causal effect of a tax increase on the pricing of cooperatives would involve a randomized change of the tax for a group of them (the "treatment" group) while keeping it constant for another group (the "control" group). In this ideal setting, spillovers should not affect cooperatives across these two groups. While our study does not rely on a randomized experiment, we exploit instead the exogenous variation in the fuel taxes across states resulting from the fiscal harmonization implemented in January 2019. Since none of the cooperative gas stations in our sample affected by the tax reform are located near an unaffected state, and vice versa (see Figure 2), the possibility of spillover effects is minimal.[18] Thus, we use this setup to estimate the causal impact by comparing the fuel prices of cooperative gas stations in treated and control states.

More precisely, our main regression model to estimate the pass-through of the tax change into retail prices is as follows

$$Price^{f}_{ist} = \alpha_0 + \alpha_1\, Tax_s + \alpha_2\, Post_t + \alpha_3\, Tax_s \times Post_t + \boldsymbol{X}'_{is} + \mu_s \times\ Brent_t + \delta_t + \lambda_i + \varepsilon_{ist} \tag{4.1}$$

where the price of fuel f, such that $f \in \{\text{diesel}, \text{gasoline}\}$,[19] at gas station i, in state s, at week t, is regressed on the following variables. First, we include the dummy variable Tax_s, which takes the value of 1 for states where the tax increased by 5.808 cents per liter (treated states) and 0 otherwise (control states). Next, we include the dummy variable $Post_t$, which is equal to 1 for all weeks from January

[18]Note, though, that some gas stations in the state of Navarra (treated) border the state of Aragón (dropped). However, as explained above, Aragón underwent only a minor fuel tax increase, reducing the likelihood of substantial spillover effects. Our results stand even when excluding these gas stations (results are available upon request).

[19]The inability of diesel drivers to purchase gasoline, and vice versa, for their vehicles, eliminates any potential short-term substitution effect between the two fuels. Thus, the unrelated nature of the demand for diesel and gasoline fuels prevents the potential occurrence of cross-tax pass-through between these products (Besanko et al., 2005; Armstrong and Vickers, 2018).

2019 onward (and 0 otherwise). Additionally, we include the interaction term between Tax_s and $Post_t$. This model specification allows us to estimate the basic difference-in-differences (*DiD*) estimator. We then successively modify and augment this standard specification as follows. First, we replace $Post_t$ with week-year fixed effects (δ_t), which account for time-varying factors that commonly affect all gas stations (e.g., fluctuations in wholesale fuel prices). Second, we introduce a vector of time-invariant variables ($\boldsymbol{X}'_{is}$) to control for certain gas station characteristics that may influence their retail prices. This vector includes a binary variable indicating whether the gas station is open 24/7, the number of different fuels it sells, the number of competing gas stations within a 2-kilometer radius, and dummy variables representing the brand of the gas station.

Next, we estimate equation (4.1) by including gas station fixed effects (λ_i), which capture any time-invariant gas station characteristics that may affect prices. For this specification, which allows us to estimate the two-way fixed effects (*TWFE*) estimator, both Tax_s and $\boldsymbol{X}'_{is}$ are omitted. Finally, we further augment this specification by incorporating the interaction between the Brent crude oil price and state dummies, which controls for the potential asymmetric impact of changes in wholesale prices on gas station prices in different states (due to, for example, proximity to refineries). It is important to remark that we include in all specifications of equation (4.1) that do not include week fixed effects a dummy representing the period after the announcement but before the tax change (July-December 2019), and we also include in all specifications the interaction term between this "announcement-period" dummy and Tax_s to account for the potential anticipation effect that the fiscal reform announcement had on cooperatives' fuel prices (Coglianese et al., 2017).[20] Moreover, in all model specifications, we cluster ε_{ist} at the zip code level.[21]

In equation (4.1), the parameter of interest is α_3, which captures the causal effect of the fuel tax increase on the prices of cooperative gas stations located in treated states. This parameter represents the pass-through of the tax into retail fuel prices. The key identifying assumption is that, in the absence of the harmonization policy, cooperative gas stations in both subsets of states would have exhibited similar price trends over time. To provide support for this assumption, below we conduct a standard

[20]To mitigate concerns regarding the validity of the *DiD* and *TWFE* estimators in settings with variations in the timing and intensity of treatment—given, in our case, by the impact of the announcement and the actual implementation of the tax reform; see Callaway and Sant'Anna (2021) and De Chaisemartin and d'Haultfoeuille (2022)—in Appendix B.1, we estimate our regression model after excluding observations occurring after the announcement but prior to the implementation.

[21]Clustering the standard errors at the zip code level yields similar results as clustering at the gas station level, as the majority of gas stations in our sample are located in different zip code areas. Our results prove robust to alternative clustering strategies.

pre-treatment parallel trend test, demonstrating that this condition is likely met. Moreover, the identification of the causal impact hinges on the nonexistence of spillover effects between gas stations in treated and control states (as previously discussed, this is improbable) and the absence of correlation between the characteristics of treated states and the characteristics of the gas stations located there. The latter assumption is also reasonable, considering the balance in key characteristics observed across gas stations in both treated and control states, as detailed in Table 1 (Panel B). In the subsequent section, we present and discuss specific robustness checks that lend further support to the plausibility of these assumptions.

5 Empirical results

5.1 Main results

We start by presenting the estimation results from equation (4.1) in Table 2 to analyze the causal effect of the 2019 tax increase on fuel prices at cooperative gas stations. Panel A shows the coefficients obtained from the analysis of diesel prices, while Panel B displays the estimates for unleaded gasoline prices. In both panels, we report the p-value of a test that examines the complete pass-through of the tax increase under the null hypothesis (H_0) that the estimated coefficient α_3 equals 0.058.

First, column (1) displays the point estimates obtained using the simple *DiD* specification, which does not incorporate any additional controls other than the announcement period dummy and its interaction with Tax_s. Panel A reveals that the coefficient of interest is equal to 0.057, indicating a near-complete pass-through of the tax increase. In column (2), we extend the model specification by introducing additional controls at the gas station level, namely, a binary variable indicating whether it operates 24/7, the number of fuels sold, the number of competitors within a 2-kilometer radius, and week-year dummies. Moreover, to account for a potential bias stemming from unobservable heterogeneity across brands, we further introduce brand dummies in column (3). In both columns (2) and (3), the coefficient of interest remains largely unchanged. Finally, in column (4), we report the results obtained from the *TWFE*, which include both week and gas station fixed effects, while column (5) additionally introduces the interaction between Brent crude oil prices and state dummies to capture potential heterogeneous effects. Again, the coefficients in these columns (0.056-0.057) closely mirror those in the preceding ones, further supporting the conclusion that cooperatives fully passed through the tax increase.

Table 2. The effect of tax reform on diesel and gasoline prices among cooperatives

	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × Post	0.0565***	0.0559***	0.0560***	0.0571***	0.0564***
	(0.00207)	(0.00210)	(0.00179)	(0.00177)	(0.00176)
Treated	-0.0280***	-0.0240***	-0.0245***		
	(0.00407)	(0.00417)	(0.00578)		
Post	0.0350***				
	(0.00133)				
R^2	0.322	0.653	0.910	0.901	0.904
P-Value H_0=0.058	0.471	0.315	0.264	0.609	0.377
N. Observations	18,225	18,225	18,225	18,225	18,225
N. Gas Stations	259	259	259	259	259
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × Post	0.0611***	0.0603***	0.0598***	0.0603***	0.0590***
	(0.00276)	(0.00261)	(0.00245)	(0.00250)	(0.00250)
Treated	-0.0424***	-0.0382***	-0.0300***		
	(0.00429)	(0.00483)	(0.00532)		
Post	-0.00486***				
	(0.00177)				
Week FE		✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.199	0.693	0.900	0.884	0.890
P-Value H_0=0.058	0.270	0.378	0.462	0.349	0.695
N. Observations	13,544	13,544	13,544	13,544	13,544
N. Gas Stations	195	195	195	195	195

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euro per liter. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level—a dummy variable indicating whether the station is open 24/7, the number of fuels sold, and the number of gas stations within a 2-kilometer radius. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors clustered at the zip code level (in parentheses). The significance levels are indicated as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The same model specifications discussed above are also included in Panel B, which displays the estimated coefficient of interest using data on gasoline prices. The coefficients obtained across all the columns in this panel closely resemble those reported in Panel A—ranging between 0.059 and 0.061. In fact, in both panels and across all model specifications, the test under the null hypothesis of complete pass-through fails to be rejected at a 10% level of significance. In other words, our analysis does not provide evidence to reject the hypothesis that the tax increase was fully passed on to retail fuel prices among cooperative gas stations, irrespective of the model specification employed. These results, which align with the preliminary evidence presented in columns (7) and (8) of Table 1 (Panel A), further confirm the absence of a markup adjustment in the pricing behavior of these firms.

These empirical findings stand in stark contrast with those obtained by Bajo-Buenestado and Borrella-Mas (2022), who study the pass-through behavior of tax changes among for-profit Spanish gas stations in the same context as our study. Their results indicate a pass-through rate of only 72% among non-vertically integrated gas stations (note that cooperative gas stations are also non-vertically integrated), suggesting a partial transmission of the tax increase to retail diesel and gasoline prices. This discrepancy highlights the existence of heterogeneity in pricing behavior among different types of firms in the market: while for-profit gas stations exhibit tax under-shifting, our analysis reveals that cooperative-owned gas stations demonstrate a complete pass-through of the tax increase, indicating the absence of markup adjustment and, ultimately, the absence of market power exertion.

5.2 Validity

The findings presented in the previous section provide compelling evidence that the fiscal harmonization policy resulted in a complete pass-through of the tax increase into retail fuel prices at the affected cooperative gas stations, implying the absence of markup adjustment. The unexpected implementation of this reform in June 2018, in the aftermath of a successful vote of no confidence, provides a clear and compelling setting for identifying its causal impact. However, to further strengthen the validity of these results, this section presents alternative tests that provide additional confidence in the causal relationship between the tax change and the observed pricing behavior at cooperative gas stations.

To begin with, a critical assumption for identifying the coefficient of interest (α_3) in equation (4.1) is that the pricing behavior of gas stations in both treated and control states would exhibit a similar time trend in the absence of the fiscal reform—that is, that the tax change should be orthogonal to ε_{ist}. A visual inspection of the temporal evolution of the average price of diesel and unleaded gasoline at both subgroups of cooperative gas stations (see Figure A.2 in Appendix A.2) provides initial evidence supporting the plausibility of this parallel trend assumption. However, we go beyond a visual inspection and perform additional empirical tests to robustly confirm this assumption.

First, we formally examine the presence of differential trends in the pricing behavior of both treated and control cooperative gas stations prior to the implementation of the tax reform. To do so, we extend our main regression model, given by equation (4.1), by introducing the interaction between the treatment dummy (i.e., Tax_s) and several dummies that take the value of 1 for the different weeks before and after the implementation of the tax change. In particular, we estimate the following regression model:

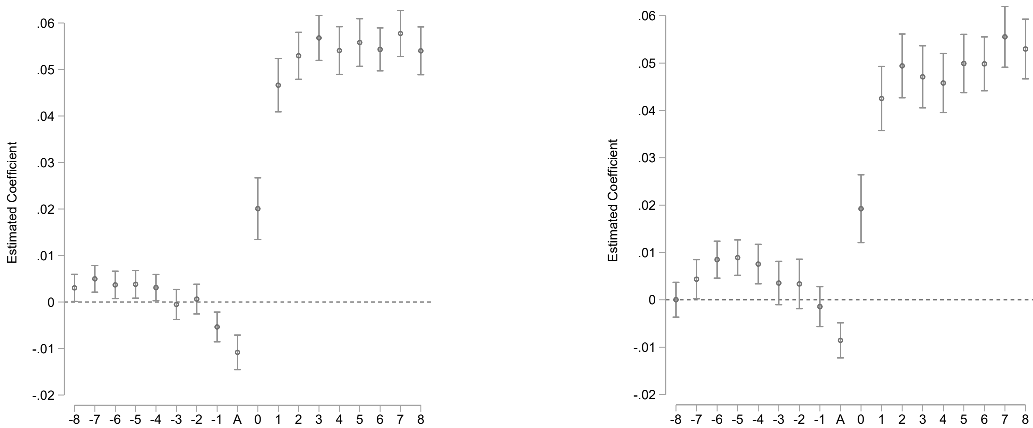
$$Price^{f}_{ist} = \beta_0 + \sum_{j=-r}^{r} \beta_{1,j}\, Tax_s \times Week_{t+j} + \mu_s \times\; Brent_t + \delta_t + \lambda_i + \varepsilon_{ist} \tag{5.1}$$

where $Week_t$ is a dummy equal to 1 for the first week after the implementation of the tax reform—while $Week_{t+j}$ is the j-th week before or after that one—and the rest of the variables are as defined above. This equation, which is an augmented version of the most complete specification of the model presented in equation (4.1), allows us to assess whether there are differential trends in pricing between the two groups. If the fuel price trends in the treatment and control cooperative gas stations are the same prior to the reform, then $\beta_{1,j}$ should be close to zero and not significant for all $j \in [-r, 0)$. This would provide evidence against the fact that the estimated effect stems from a previously existing trend, instead of the 2019 tax harmonization. On the contrary, $\beta_{1,j}$ should be positive and significant for all $j \in [0, r]$, that is, right after the tax reform.

Figure 4 shows the estimated impact on diesel prices (Panel A) and unleaded gasoline prices (Panel B) on a week-by-week basis. The analysis covers up to eight weeks prior to the announcement of the tax reform in June 2018, the week of its announcement (indicated as A on the horizontal axis), and the eight subsequent weeks following its implementation in January 2019.[22] The coefficients for the lead weeks are close to zero, and most of them are statistically insignificant for both fuels, indicating that the price changes were not attributable to preexisting trends among the treated cooperative gas stations.

[22] In Appendix B.6, we provide figures that display the complete set of point estimates, encompassing also each week from the announcement of the reform to its actual implementation (see Figure B.1).

Figure 4. Impact on cooperative diesel and gasoline prices before the announcement and after the implementation of the tax reform



(A) Diesel

(B) Gasoline

Note: The figure shows the estimated impact of the January 2019 tax harmonization reform on the prices of diesel (Panel A) and unleaded gasoline (Panel B) for cooperative gas stations before its announcement and after its implementation. The estimates are obtained using the most complete specification of equation (5.1)—used in column (5) in Table 2—, augmented with week-by-week leads and lags dummy variables interacted with Tax_s. Vertical bands represent a 90% confidence interval. Point estimates are displayed for up to 8 weeks before the announcement of the tax reform, for the week of its announcement (indicated with A), and for up to 8 weeks after its implementation.

By contrast, all coefficients after the implementation of the tax change are statistically significant, which are, on average, at around 0.05-0.06.[23] These findings provide further evidence that the tax increase had a positive impact on retail fuel prices only after January 2019.

Second, to further strengthen the validity of the empirical results discussed above, we present additional evidence that the price increase observed among cooperatives after the fiscal reform is specific to the fuels affected by the tax change, namely, unleaded gasoline and diesel. To do so, we examine whether there is a corresponding price increase in other energy products sold by the same cooperatives in our sample that were not impacted by the tax reform in January 2019. Specifically, we estimate equation (4.1) using the prices of non-road diesel (referred to as "Diesel B" in Spain), which is exclusively used in machinery, tractors, and similar agricultural devices. The rationale behind this analysis is that there should be no significant differences in non-road diesel prices among cooperative gas stations, as this fuel was not subject to the 2019 tax reform. Consequently, if the estimated coefficient α_3 is close to

[23]Note that in the initial weeks following the implementation of the fiscal reform, the coefficients are below 0.05, indicating an under-shift of the tax. This phenomenon can be attributed to a lagged price adjustment caused by inventory holding by refiners and/or gas stations (Borenstein and Shepard, 2002; Levin et al., 2017). However, it is noteworthy that after the fifth week (Panel A) or sixth week (Panel B), a complete pass-through of the tax increase is observed.

Table 3. The effect of tax reform on nonroad diesel prices among cooperatives

	(1)	(2)	(3)	(4)	(5)
Tax × *Post*	0.00291	0.00276	0.00122	0.00175	0.000619
	(0.00331)	(0.00342)	(0.00301)	(0.00297)	(0.00309)
Treated	-0.00820	0.00303	0.0286^{***}		
	(0.00607)	(0.00617)	(0.00612)		
Post	0.0487^{***}				
	(0.00232)				
Week FE		✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.258	0.466	0.891	0.827	0.835
N. Observations	13,270	13,270	13,270	13,270	13,270
N. Gas Stations	189	189	189	189	189

Note: The outcome is nonroad diesel price in euros per liter. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level—a dummy variable indicating whether the station is open 24/7, the number of fuels sold, and the number of gas stations within a 2-kilometer radius. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

zero and statistically insignificant, it would alleviate concerns about potential time-varying unobservable factors influencing fuel prices across gas stations in the states affected by the fiscal harmonization.

The results of this additional empirical exercise are presented in Table 3. Across all model specifications, the estimated coefficient of interest is consistently close to zero and not statistically significant. These findings provide additional support for our main empirical results, indicating that the observed price increases among cooperatives can be solely attributed to the fiscal harmonization reform rather than being influenced by other time-varying unobserved factors.

5.3 Robustness checks

In this section, we conduct a battery of robustness checks using alternative specifications and sample restrictions to reinforce the main findings presented in Table 2.

5.3.1 Market competition

One potential concern is that the observed results may not solely be attributed to the absence of for-profit-seeking behavior but rather to the presence of nearby competitor gas stations. As discussed in Section 3, the full pass-through of a tax shock can be expected not only from firms with market power aiming to maximize total surplus or total output but also from for-profit firms operating in a perfectly competitive environment (Alm et al., 2009; Ganapati et al., 2020). While assuming such an environment in retail fuel markets may seem unusual, given the widespread recognition that fuel retailers often exercise market power and deviate from efficient pricing (Deltas, 2008), it is still plausible to consider the role of market competition in driving our main findings: the presence of rival gas stations may influence cooperatives to set their prices closer to their marginal costs.

We address this concern by reestimating the equation (4.1) using a subset of cooperative gas stations located in areas where there is no nearby competition in their local markets. Specifically, we focus our analysis on gas stations that have no rivals within a 2-kilometer radius. Since assuming that these "isolated" gas stations operate in a perfectly competitive environment may seem even more implausible, this test allows us to assess the extent to which our results are driven by the absence of for-profit behavior rather than competitive market conditions. We present the estimates of this robustness check using diesel prices (Panel A) and unleaded gasoline prices (Panel B) in Table 4, following the same structure as in Table 2. Across all the model specifications and for both fuels, the coefficient of interest consistently remains positive and equal to 0.054-0.055. Moreover, in all the cases considered, the estimates are not statistically indistinguishable from full pass-through—in fact, we fail to reject the null hypothesis of full pass-through of the tax increase at the less stringent (10%) level of significance. These findings suggest once again that even cooperative gas stations that face no nearby competition exhibit a similar pattern of pass-through, providing further support for the absence of markup adjustment in their pricing behavior.

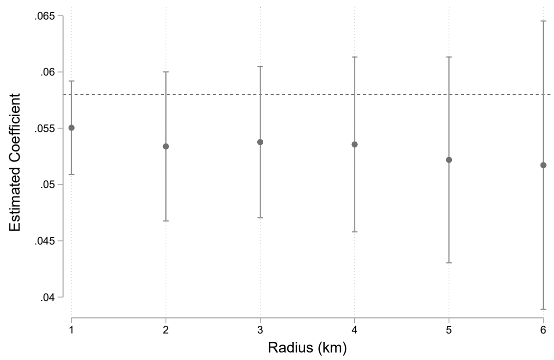
Still, one might raise concerns about the arbitrariness of the 2-kilometer threshold used in the analysis above. In fact, previous studies employ alternative thresholds to define local markets in the context of transportation fuel retailers, as exemplified by Carranza et al. (2015) and Luco (2019). To address this potential concern, we extend the analysis by estimating our most complete model specification—including gas station fixed effects, week fixed effects, and interactions between state-specific dummies and the Brent crude oil price—using cooperative gas stations that face no competition within increasing

Table 4. The effect of tax reform on diesel and gasoline prices among cooperatives without nearby competitors

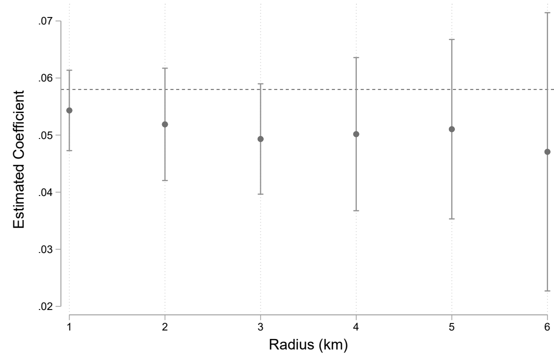
	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × *Post*	0.0545***	0.0538***	0.0547***	0.0546***	0.0534***
	(0.00403)	(0.00396)	(0.00332)	(0.00332)	(0.00338)
Treated	-0.0384***	-0.0327***	-0.0399***		
	(0.00875)	(0.00767)	(0.0105)		
Post	0.0360***				
	(0.00333)				
R^2	0.318	0.620	0.925	0.886	0.893
P-Value H_0=0.058	0.389	0.297	0.318	0.316	0.177
N. Observations	4,925	4,925	4,925	4,925	4,925
N. Gas Stations	71	71	71	71	71
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × *Post*	0.0537***	0.0542***	0.0539***	0.0537***	0.0519***
	(0.00535)	(0.00575)	(0.00500)	(0.00498)	(0.00502)
Treated	-0.0568***	-0.0512***	-0.0439***		
	(0.0109)	(0.00987)	(0.00464)		
Post	-0.00446				
	(0.00346)				
Week FE		✓	✓	✓	✓
Brand FE			✓		
Gas Station Characteristics		✓	✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.234	0.636	0.910	0.855	0.871
P-Value H_0=0.058	0.429	0.513	0.420	0.391	0.229
N. Observations	3,196	3,196	3,196	3,196	3,196
N. Gas Stations	46	46	46	46	46

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euros per liter. We restrict the sample to those gas stations that have no other competitor in a radius of 2 km. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level—a dummy variable indicating whether the station is open 24/7, the number of fuels sold, and the number of gas stations within a 2-kilometer radius. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors are clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 5. The effect of tax reform on diesel and gasoline prices for increasingly isolated cooperative gas stations



(A) Diesel



(B) Gasoline

Note: The figure displays the estimated impact of the June 2019 tax harmonization reform on the prices of diesel (Panel A) and on unleaded gasoline prices (Panel B) for cooperative gas stations. The estimates are obtained for different samples of gas stations, categorized by their lack of competition within a radius ranging from 1 to 6 kilometers (in 1-kilometer increments), as denoted on the horizontal axis. Point estimates (indicated by dots) are obtained using the most complete specification of equation 4.1—used in column (5) in Table 2. Vertical bands represent 95% confidence intervals. The dashed horizontal line captures the threshold for full tax pass-through (at 0.058).

thresholds. Specifically, we consider gas stations with no competitors in concentric circles with a radius increment of 1 kilometer around each gas station, ranging up to 6 kilometers. The results of this additional empirical exercise are presented in Figure 5, with Panel A focusing on diesel prices and Panel B on unleaded gasoline prices. In both cases, our results consistently fail to reject the null hypothesis of full pass-through (indicated by the horizontal dotted line in both panels) at the 5% significance level across the different considered thresholds.[24] Thus, our main result that cooperative gas stations do not engage in markup adjustments remains robust to alternative definitions of isolated firms.

These findings stand in stark contrast with the results obtained by Genakos and Pagliero (2022) and Dimitrakopoulou et al. (2023). In their studies, they examine the pass-through behavior of tax changes among for-profit gas stations operating in isolated markets in Greece. Their estimates suggest that these isolated gas stations pass through only approximately 40-50% of the tax change, indicating that a significant portion of the tax is absorbed through their markups—which arise from the exercise of market power. This disparity highlights the distinct behavior observed between (isolated) for-profit gas stations and cooperative gas stations, as the latter demonstrate a near-complete pass-through of the tax increase, further supporting the absence of markup adjustment in their pricing policy.

[24] Note that as we consider increasingly isolated firms, the number of observations decreases, leading to wider confidence intervals.

5.3.2 Additional robustness checks

Our results remain robust across various alternative sample selection criteria and estimation strategies, which can be found in Appendix B. In this section, we provide a summary of the extensive analysis presented in that appendix. In all these alternative scenarios, we consistently observe a complete pass-through of the tax into retail prices among cooperative gas stations.

First, as explained in Section 4.2, in equation (4.1), we control for the period spanning from the announcement of the tax reform to its implementation. More precisely, in all the specifications of our regression model, we include the interaction term of a dummy variable that equals 1 during the June-December 2018 period and the "treatment" variable (Tax_s). This adjustment addresses the potential anticipation effect induced by the fiscal reform announcement (Coglianese et al., 2017). However, recent research has raised concerns about the validity of *DiD* designs involving varying treatment timing and intensity (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; De Chaisemartin and d'Haultfoeuille, 2022). In our study, such variation may stem from the influence of both the announcement and the subsequent actual implementation of the reform. To mitigate this potential concern, we estimate our model with the exclusion of observations following the announcement and preceding the implementation of the tax reform. By doing so, our setup resembles the conventional *DiD* setup with just two periods ("pre" and "post") and two groups ("treatment" and "control"). The results of this exercise, which can be found in Appendix B.1 (Table B.1), closely mirror those presented in Table 2.

Next, in Section 2.3, we elaborate on the unexpected nature of the tax harmonization reform that we exploit in our empirical analysis. This reform was unpredictably passed by a newly established left-wing government resulting from a vote of no confidence. Nevertheless, it is noteworthy that the preceding (right-wing) government had already contemplated a similar reform in the preliminary draft of the Spanish national budget, made public in April 2018. Even though it received limited media coverage, there remains the possibility that this preliminary bill could have triggered a preemptive reaction among the affected cooperatives. Therefore, to address this potential concern, we estimate again equation (4.1) controlling for the period spanning from the last week of April 2018 to the week right before the actual announcement in June 2018. More precisely, we introduce an additional dummy variable that equals 1 for the weeks within this time frame interacted with Tax_s. The results of this second robustness check, included in Appendix B.2 (Table B.2), exhibit a remarkable consistency with those displayed in Table 2.

Third, another concern arises from the unbalanced structure of our panel dataset—which is a common issue when examining markets with firm entry and exit. To address this problem, we replicate the results from Table 2 using a balanced panel of cooperatives. Specifically, we use the subsample of gas stations that remain selling fuel in the market from January 2018 to mid-2019.[25] Table B.3 displays the estimates for both fuels under this approach; once again, the empirical results remain virtually unchanged compared to those of the full sample in Table 2.

Next, we further ensure that our main findings are not driven by specific subsets of cooperative gas stations or by those located in a particular state. To this end, we reestimate our main regression model using certain subsets of cooperatives from our sample. These additional robustness checks, carried out using the most complete specification of equation (4.1) for both diesel and unleaded gasoline, are included in Table B.4 (Appendix B.4). Panel A displays the estimates of the coefficient of interest using data from three distinct subgroups of cooperatives: *(i)* gas stations owned by Eroski and AN Energeticos (large cooperatives),[26] *(ii)* all cooperatives with more than two gas stations, excluding Eroski and AN Energeticos (medium-sized cooperatives), and *(iii)* all cooperatives with only one gas station (small cooperatives). Additionally, Panel B presents the same set of results after excluding one treated state (i.e., those affected by the tax reform). The results included in this table confirm that our findings remain robust, as they show consistency both quantitatively and qualitatively with those presented in column (5) in Table 2, re-ensuring that they are not driven by any specific cooperative brand (or group of cooperatives) or particular subsets of gas stations within a single state.

Finally, as an additional empirical analysis, we estimate the impact of the tax reform on the prices of cooperatives in states where fuel duties experienced only minor increases, namely, Aragón (with a tax increase of 2.9 cents per liter) and Extremadura (with an increase of 1.2 cents per liter)—see Figure 2.[27] To this end, we augment our regression model by introducing additional dummy variables, each representing one of the mentioned states. Then, we estimate the coefficients of the interaction between these dummies and $Post_t$. The results of this empirical analysis are presented in Table B.5 (see

[25] For diesel fuel, 79% of the cooperative gas stations in our sample satisfy this criterion, while for unleaded gasoline, the number is 80%. A brief reporting lapse of 4 weeks, possibly due to holidays, was observed.

[26] Excluding these two brands from our analysis is noteworthy, as they may also use fuel prices to attract customers to their other businesses.

[27] In this analysis, we exclude the state of Asturias (which experienced a modest 1 cent increase solely for diesel), as it has only three gas stations owned by cooperatives. Additionally, there are no cooperative gas stations in the state of Madrid, which also experienced a partial increase in fuel duties.

Appendix B.5). Once again, all the point estimates associated with gas stations in these states align with a full pass-through of the respective tax changes, except for diesel in Aragón, where the null hypothesis of full pass-through is rejected in three columns at the 5% level (although it is not rejected at the 1% level). However, readers should interpret these findings with caution for two main reasons. First, concerns about the validity of the *TWFE* and *DiD* estimators arise in settings with multiple treatments (Fricke, 2017; De Chaisemartin and d'Haultfoeuille, 2020, 2023). As explained by De Chaisemartin and d'Haultfoeuille (2023), such contexts may yield incorrectly estimated coefficients, as they capture not only the effect of a particular treatment but also the effects of other treatments. Secondly, the limited sample size in certain regions warrants careful consideration.

6 Conclusion and policy implications

In this paper, we empirically study the competitive behavior of cooperatives. Specifically, we examine whether cooperatives exercise market power when setting prices or, conversely, if their behavior is rather aligned with efficiency pricing. Although the cooperatives within our study ostensibly share a common goal, often formalized in their by-laws and charters, of maintaining competitive prices to benefit their customers and promote societal impact, previous literature has raised questions regarding the extent to which these objectives are genuinely pursued. This skepticism finds roots, for example, in the potential dissonance between managerial incentives and the cooperatives' socially oriented goals, and the intricate influence of particular economic groups (Birchall, 2014).

Our empirical analysis takes root in a well-established theoretical framework that formalizes the conditions under which the pass-through of an exogenous tax shock serves as a straightforward test for market power. Guided by this premise, we leverage a dataset on daily pricing data (aggregated on a weekly basis) and other characteristics from over 250 cooperatives engaged in the transportation retail fuel sector across Spain. We use it to exploit the enactment of regional fuel tax harmonization in June 2019 within Spain—an outcome that unexpectedly emerged after a successful vote of no confidence—which precipitated an unforeseen spike in fuel cost of approximately 11% for gas stations in some states. This regulatory change allows us to examine the tax pass-through exhibited by the affected cooperatives using a standard difference-in-differences approach.

We find that the tax shock experienced by cooperatives operating in states affected by fiscal harmonization was entirely transmitted to their retail diesel and gasoline prices: for both fuel types, we fail to reject the null hypothesis of full pass-through. This result, consistent across a battery of robustness checks, reveals the absence of any markup adjustment among these cooperatives and cohesively aligns with efficient (welfare-maximizing) pricing. It also diverges from the tax adjustment patterns observed among for-profit gas stations in closely related studies. For example, Bajo-Buenestado and Borrella-Mas (2022) report a pass-through rate of 72%, while Genakos and Pagliero (2022) demonstrate a pass-through rate as low as 40% for gas stations in competition-deprived settings. In our case, the full pass-through rate is observed even for the subset of cooperatives without nearby competitors.

Our examination of cooperative behavior introduces a nuanced departure from existing literature. While prior researchers, such as Duggan (2002), Philipson and Posner (2009), and Duarte et al. *(forthcoming)*, suggest that cooperatives and not-for-profit firms often deviate from their stated objectives by exploiting market power, our findings unveil a trajectory aligned with the "pro-social" principles enshrined in their charters. This conclusion gains prominence given the breadth of our dataset, incorporating information from over 250 cooperatives, spanning a diverse array of entities—ranging from small and medium-sized agricultural cooperatives to a hybrid consumer-worker cooperative with a widespread national presence. This comprehensive coverage stands in stark contrast to earlier studies, frequently limited to a mere one or a few cooperatives.

Our empirical findings, suggesting that the bulk of cooperatives studied here adhere to their consumer-oriented objectives—a counternarrative to the prevailing discourse in the literature—highlight the need for policymakers to abandon a one-size-fits-all approach when regulating cooperatives. Instead of assuming that cooperatives universally exert market power, a nuanced evaluation of subgroups of cooperatives' behavior and governance structure would provide a better understanding of the gains of granting exemptions for not-for-profit firms. It is crucial to consider the diverse outcomes observed across industries and organizational forms, emphasizing the necessity for tailored policy frameworks that account for the specificities of each cooperative. Blindly extending such exemptions may not be warranted, and subsidies must be rigorously evaluated against the actual benefits they provide to consumers. In summary, policymakers play a pivotal role in fostering environments where not-for-profit firms genuinely serve the interests of their members and consumers.

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Appendix A: Additional background and theoretical figures

A.1 Fuel prices in cooperative and for-profit gas stations

Figure 1 in Section 1 illustrates the difference in the evolution of retail diesel prices—the predominant transportation fuel in Spain—between cooperatives and for-profit gas stations throughout our sample period. For the sake of completeness, we present a similar figure for retail gasoline prices (another fuel considered in our empirical analysis) in this appendix. In line with the findings in Figure 1, Figure A.1 also depicts a consistent 6-7 euro cents lower price for gasoline at cooperative-owned gas stations compared to their for-profit counterparts. As discussed in Section 1, this observed difference aligns with the estimated gas station markup suggested by the CNMC (2017), providing compelling preliminary evidence supporting the absence of any markup among cooperative gas stations.

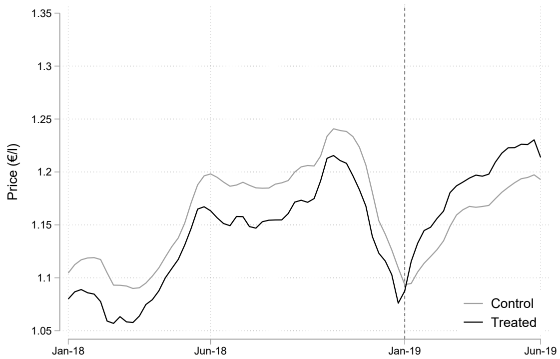
Figure A.1. Average weekly gasoline price of cooperative and for-profit gas stations

Note: The figure displays the average weekly retail price (in euros per liter) of gasoline from the first week of 2018 to the first week of June 2019. The solid dark gray line represents the average price for for-profit gas stations, while the solid light gray line represents the average price for cooperative gas stations. The dataset was obtained from *Geoportal* (Spanish Ministry for the Ecological Transition).

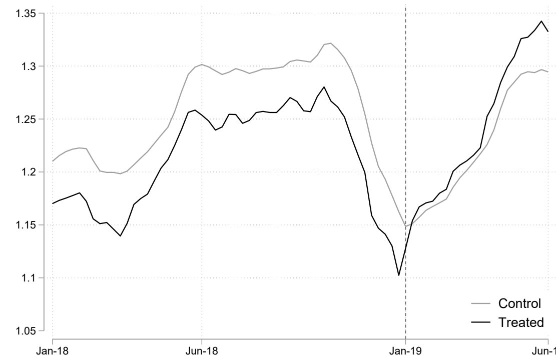
A.2 Fuel price differences in treated and control gas stations

In Section 5.2, we state that a key assumption for identifying the causal impact of the tax increase on the prices of cooperative gas stations in treated states is that the pricing behavior of gas stations in both treated and control states would follow a similar time trend in the absence of the fiscal harmoniza-

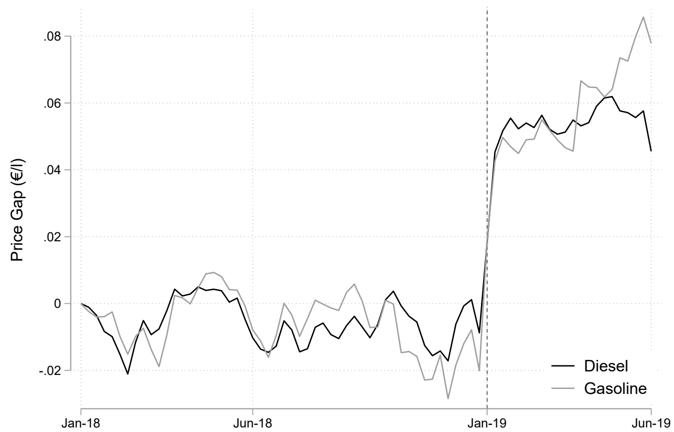
Figure A.2. Average diesel and gasoline retail prices in all cooperative gas stations in control and treated states



(A) Diesel prices



(B) Gasoline prices



(C) Price gap (both fuels)

Note: This figure illustrates the difference in average retail fuel prices across all cooperative gas stations in control and treated states throughout our sample period. Panel A captures this difference for retail diesel prices, while Panel B does the same for retail gasoline prices. In both figures, the dark line represents the average price in cooperatives located in the treated area, while the gray line represents the average price for those in the control area. The vertical dashed line indicates the week when tax harmonization was implemented (January 2019). Panel C shows the price gap between both areas for both fuels, with the dark line representing the difference in diesel prices and the gray line representing the difference in gasoline prices. For ease of visual comparison, the gap for both fuels is normalized to zero in the first week of 2018.

tion implemented. This appendix provides additional visual evidence—see Figure A.2—supporting the plausibility of such an assumption.

First, Panels A and B show the temporal evolution of the average prices of diesel and unleaded gasoline, respectively, in both treated and control cooperative gas stations from our sample. These figures indicate a fairly similar price evolution at both subsets of gas stations, with alterations only surfacing after the implementation of the tax reform (January 2019). This provides descriptive evidence in favor of the parallel trend assumption. The same trend is corroborated by Panel C, which depicts the price difference between gas stations in treated and control states for both fuels. Before January 2019, the price difference in both subsets of gas stations was negligible. However, after the tax reform, we observe a substantial increase in the price difference between gas stations in treated and control states, approximately 5.5-6 cents. This observed jump in the raw data aligns in magnitude with the increase in the fuel duty experienced by gas stations in treated states, further suggesting that these gas stations fully passed through the tax change.

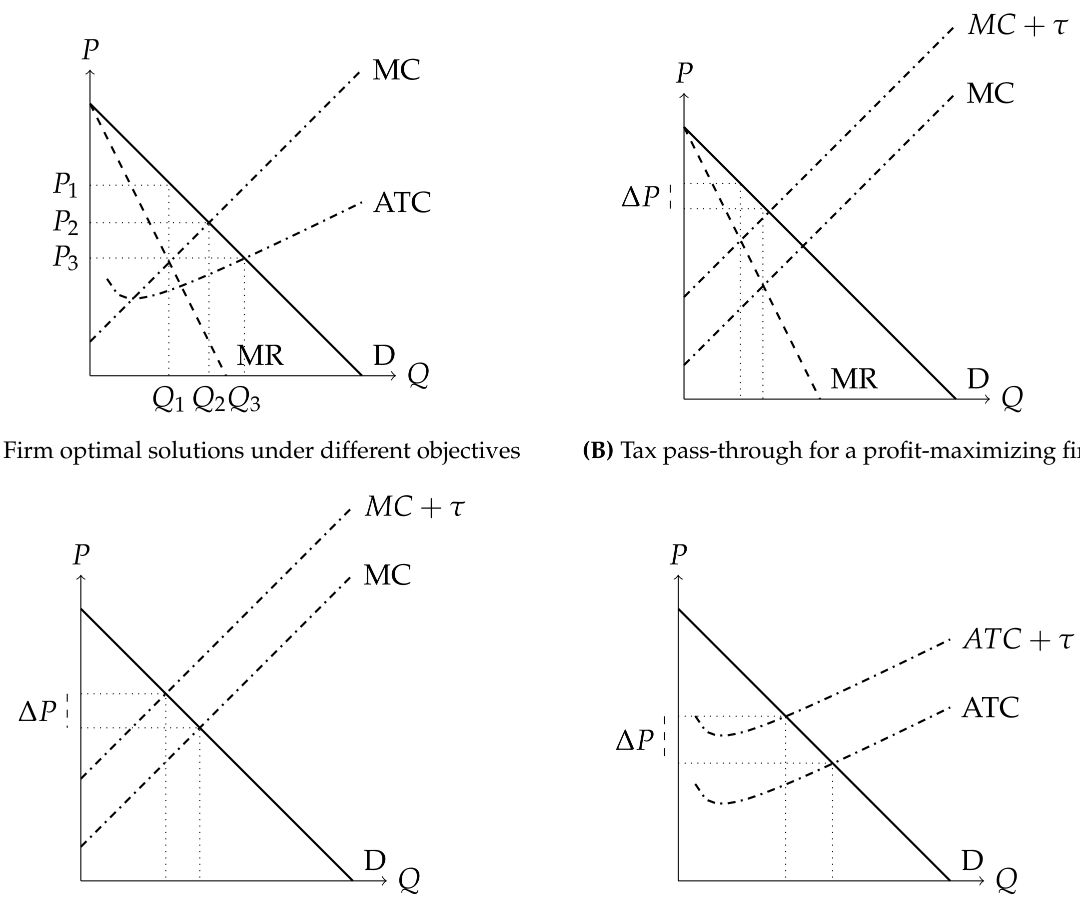
A.3 Tax pass-through under different objectives (increasing marginal cost)

To put the empirical work in context, in Section 3 we provide a concise overview of how a per-unit tax change is passed through to final prices in the presence of market power when a firm pursues diverse objectives. To maintain coherence with our empirical setting, we assumed a constant marginal cost, reflecting the linear nature of contracts gas stations in our context typically engage in with upstream suppliers (refiners)—this type of contract is widely prevalent in transportation fuel markets between refiners and gas stations across many other countries (Manuszak, 2010). In this appendix, we extend our analysis to the case in which the marginal cost is not held constant. As illustrated in Figure A.3, under this alternative assumption, our main theoretical predictions and conclusions outlined in Section 3 persist.

First, we examine the scenario in which a firm maximizes its profits. In this case, the optimal price (P_1 in Figure A.3, Panel A) is determined by the intersection of the firm's marginal revenue (MR) and marginal cost (MC), resulting in a positive markup. Therefore, an increase in the per-unit tax (τ) raises its costs and, consequently, its price. However, due to the presence of the markup, the tax increase is not fully passed onto the final consumers. Instead, the firm absorbs a portion of the tax through its markup, as illustrated in Figure A.3, Panel B.

Second, we consider the case where the firm maximizes total surplus. Under this objective, the firm optimally sets prices at marginal cost, eliminating the price markup and resulting in a lower final price relative to its profit-maximizing counterpart (P_2 in Figure A.3, Panel A). Unlike the previous case, in this scenario, there is no markup adjustment after the increase in the tax, as demonstrated in Figure A.3, Panel C. Consequently, the price increase (ΔP) is not adjusted downward, leading to a strictly greater pass-through of the tax compared to the case in which the firm maximizes profits. The same result holds

Figure A.3. Firm pricing behaviour and tax pass-through under different firm objectives (increasing marginal cost)



(A) Firm optimal solutions under different objectives

(B) Tax pass-through for a profit-maximizing firm

(C) Tax pass-through for a surplus-maximizing firm

(D) Tax pass-through for an output-maximizing firm

Note: The figure illustrates the optimal solution achieved by a firm facing an increasing marginal cost under different objectives (Panel A), and the effect of a tax (τ) increase on the price for each of the objectives considered (Panels B-D), given the demand (D) and the corresponding marginal revenue (MR), the marginal cost (MC), and the average total cost (ATC). In Panel A, the price and quantity pairs chosen by a profit-maximizing firm (P_1, Q_1), a surplus-maximizing firm (P_2, Q_2), and an output-maximizing firm (P_3, Q_3) are depicted, representing the intersections of MR and MC, D and MC, and D and ATC, respectively. Panel B demonstrates the impact of the tax increase on the price of a profit-maximizing firm. Due to the existence of a price markup, the tax is not fully passed through to the price. Panel C shows the impact of the tax increase on the price of a surplus-maximizing firm, while Panel D illustrates the same for an output-maximizing firm. In both cases, the price increase is not adjusted downward, leading to a greater pass-through of the tax compared to the case in which the firm maximizes profits.

if the firm's objective is to maximize total output, as depicted in Panel D of Figure A.3. In this case, the optimal solution occurs when the price equals the average total cost (ATC), resulting in no price markup. Consequently, an increase in the per-unit tax raises the firm's average total cost, once again leading to a pass-through of the tax increase into the final price greater than that in which the firm maximizes profits.

Appendix B: Robustness checks and additional empirical results

While we believe that our empirical strategy robustly supports the causal interpretation of the estimates in Section 5, we acknowledge that alternative sample selections and definitions of treatment and control groups could have been considered. In this appendix, we present several checks to ensure that our results remain robust and are not sensitive to the choices made throughout the paper.

B.1 Dropping announcement period

First, as explained in Section 4.2, all specifications of equation (4.1) control for the period spanning from the announcement to the implementation of the tax reform. Specifically, we include the interaction term of a dummy variable that equals 1 during the June-December 2018 period and Tax_s (treatment). This inclusion addresses potential anticipation effects induced by the announcement of the tax reform. However, the presence of these two periods (i.e., the announcement period and the fiscal reform period) in our main regression model raises concerns regarding the validity of *DiD* designs involving varying treatment timing and intensity (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; De Chaisemartin and d'Haultfoeuille, 2022). To mitigate this potential concern, we estimate equation (4.1) by excluding the announcement period. This adjustment aligns our setup with the conventional *DiD* framework with two periods ("pre" and "post") and two groups ("treatment" and "control"). The empirical results are presented in Table B.1.

In this table, we observe that our main results remain remarkably consistent with those presented in Table 2. Specifically, in column (5), which includes the most robust specification of our main regression model, the coefficient of interest is 0.056 for diesel (Panel A) and 0.058 for gasoline (Panel B). In both cases, we cannot reject the null hypothesis that the change in retail fuel prices is statistically indistinguishable from 0.058 at the 10% level of significance. Therefore, once again, our empirical results suggest a full pass-through of the tax change into the retail prices at cooperative gas stations.

B.2 Controlling for previous weeks to the announcement

In Section 2.3, we explained that the previous national government, prior to the vote of no confidence, had already considered a tax harmonization reform in the preliminary draft for the Spanish

Table B.1. The effect of tax reform on diesel and gasoline prices among cooperatives (dropping the announcement period)

	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × Post	0.0565***	0.0559***	0.0559***	0.0570***	0.0557***
	(0.00207)	(0.00210)	(0.00182)	(0.00179)	(0.00176)
R^2	0.282	0.644	0.912	0.909	0.914
P-Value $H_0 = 0.058$	0.471	0.309	0.241	0.568	0.197
N. Observations	10,736	10,736	10,736	10,736	10,736
N. Gas Stations	259	259	259	259	259
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × Post	0.0611***	0.0603***	0.0590***	0.0599***	0.0576***
	(0.00276)	(0.00260)	(0.00245)	(0.00250)	(0.00248)
Week FE		✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.0775	0.660	0.892	0.883	0.895
P-Value $H_0 = 0.058$	0.270	0.374	0.674	0.455	0.864
N. Observations	7,987	7,987	7,987	7,987	7,987
N. Gas Stations	195	195	195	195	195

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euros per liter. We drop the observations of the announcement period (June-December 2018). Column (1): simple *DiD* estimator. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors are clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

national budget in April 2018, which closely resembled the one announced in June 2018. Despite receiving limited media coverage, there remains the possibility that this preliminary bill could have triggered a preemptive reaction among cooperatives located in treated states. Therefore, an additional concern arises regarding a potential anticipation effect triggered by this preliminary draft, not accounted for in our main regression model. To address this concern, we re-estimated equation (4.1), this time also controlling for this pre-announcement period. Specifically, we included in all specifications of equation (4.1), excluding those with week-fixed effects, a dummy variable that equals one from the last week of April until the week before the announcement of the actual tax reform in June 2018. Additionally, we included in all specifications the interaction term between this "pre-announcement period" dummy and

Tax_s. The results of this second robustness check are presented in Table B.2.

Table B.2. The effect of tax reform on diesel and gasoline prices among cooperatives (expanding the announcement period)

	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × *Post*	0.0575***	0.0571***	0.0573***	0.0584***	0.0565***
	(0.00221)	(0.00224)	(0.00196)	(0.00194)	(0.00194)
R^2	0.385	0.653	0.910	0.901	0.904
P-Value $H_0 = 0.058$	0.836	0.702	0.724	0.837	0.429
N. Observations	18,225	18,225	18,225	18,225	18,225
N. Gas Stations	259	259	259	259	259
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × *Post*	0.0632***	0.0625***	0.0621***	0.0626***	0.0584***
	(0.00291)	(0.00279)	(0.00267)	(0.00271)	(0.00271)
Week FE	✓	✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.247	0.693	0.900	0.885	0.890
P-Value $H_0 = 0.058$	0.0765	0.107	0.128	0.0914	0.895
N. Observations	13,544	13,544	13,544	13,544	13,544
N. Gas Stations	195	195	195	195	195

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euros per liter. We add a dummy variable indicating the period that goes from the last week of April until the announcement in June 2018, and its interaction with the treatment (tax) dummy. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors are clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Once again, the coefficients in Table B.2 closely resemble those in Table 2. For diesel (Panel A), the coefficient of interest ranges between 0.057 and 0.059 across all model specifications in columns (1) to (5). In each case, we fail to reject the null hypothesis that this coefficient equals 0.058, consistently demonstrating a full pass-through of the tax change among cooperative gas stations in treated states. A fairly similar pattern is observed in Panel B for gasoline prices. However, columns (1) and (4) display coefficients slightly higher in magnitude than those in the corresponding columns in Table 2. Nevertheless, when we include the full set of controls and the most granular set of fixed effects, namely, in the most robust specification of our regression model—see column (5)—, the coefficient of interest equals 0.058, precisely matching the tax change; once again, this result demonstrates consistency with a complete pass-through of the tax into retail fuel prices.

B.3 Balanced panel (dropping gas stations that enter/exit)

Table 1 in Section 4.1 reveals a discrepancy in the number of gas stations between the "before" (January-December 2018) and "after" (January-June 2019) periods. This disparity may stem from some cooperative gas stations entering or exiting the market during the period covered by our sample. Consequently, there is a potential concern regarding attrition bias; e.g., one could argue that gas stations with lower prices may have been disproportionately affected by the tax implementation in the treated states, leading them to exit the market due to increased costs. This could introduce bias into the estimated coefficients. To address this concern, we conduct an additional robustness check using a perfectly balanced panel of cooperative gas stations. Specifically, we include only those gas stations that were actively operating in the market throughout the entire period covered by our sample.

The results of this additional empirical analysis are presented in Table B.3, where we include the same model specifications as in Table 2. The estimated coefficients in Table B.3 closely resemble those included in Table 2: across Columns (1) to (4), the estimates show minimal variation compared to those in Table 2, ranging from 0.0579 to 0.0583 for diesel and from 0.0596 to 0.0599 for gasoline. Furthermore, our primary specification in Column (5) indicates a complete pass-through of the tax change, with estimated coefficients of 0.057 for diesel (Panel A) and 0.058 for gasoline (Panel B), reaffirming once more the absence of markup adjustment among cooperative gas stations for both fuels.

B.4 Alternative samples by cooperative size/brand and states

In this appendix, we further ensure that our main findings are not driven by specific subsets of cooperative gas stations or by those located in certain treated states. To this end, we re-estimate our main regression model using various subsets of cooperatives from our sample. These additional robustness checks, obtained using the most complete specification of equation (4.1) for both diesel and unleaded

Table B.3. The effect of tax reform on diesel and gasoline prices among cooperatives (balanced panel)

	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × Post	0.0580***	0.0583***	0.0579***	0.0580***	0.0572***
	(0.00191)	(0.00191)	(0.00190)	(0.00191)	(0.00192)
R^2	0.332	0.663	0.912	0.904	0.907
P-Value $H_0 = 0.058$	0.987	0.868	0.974	0.987	0.679
N. Observations	15,170	15,170	15,170	15,170	15,170
N. Gas Stations	205	205	205	205	205
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × Post	0.0596***	0.0599***	0.0597***	0.0596***	0.0580***
	(0.00261)	(0.00260)	(0.00262)	(0.00262)	(0.00262)
Week FE		✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.203	0.704	0.902	0.887	0.893
P-Value $H_0 = 0.058$	0.534	0.463	0.519	0.535	0.987
N. Observations	11,544	11,544	11,544	11,544	11,544
N. Gas Stations	156	156	156	156	156

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euros per liter. We keep gas stations that have fully reported prices in the time interval to have a perfectly balanced panel. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors are clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

gasoline, are presented in Table B.4.[28]

In Panel A, we present estimates of the coefficient of interest using data from three distinct subgroups of cooperatives. First, we consider gas stations owned by Eroski and AN Energeticos, two relatively large cooperatives that own gas stations along with other businesses in our sample. Second, we analyze mid-size cooperatives that own multiple gas stations, excluding Eroski and AN Energeticos. Finally, in the third row, we narrow the sample to the smallest cooperatives that own and manage just one gas station. Then, Panel B displays the same set of results after excluding one treated state (Cantabria, País Vasco, La Rioja, Navarra, and Castilla y León). In both panels, the coefficients closely align with those in Table 2, ranging from 0.055 to 0.060 for both diesel and gasoline, with slight downward deviations observed only for the coefficients of the smallest cooperatives. However, even in these cases, the null hypothesis of full pass-through cannot be rejected at either the 5% or 10% level of significance. Overall, these results confirm that our findings are unlikely driven by any specific cooperative brand or group of cooperatives, nor by particular subsets of gas stations within a single state.

Table B.4. Robustness check by cooperative size/brand and geographic region

	Diesel				Gasoline			
Time	Beta	p-value $H_0 = 0.058$	Obs	N. Gas Stations	Beta	p-value $H_0 = 0.058$	Obs	N. Gas Stations
Panel A. Estimates by brand/size								
Eroski and AN	0.0571	0.836	5,402	73	0.0587	0.885	4,884	66
Coops with ≥ 2 gas stations	0.0579	0.980	1,628	22	0.0521	0.057	1,332	18
Coops with 1 gas station	0.0527	0.094	8,140	110	0.0479	0.215	5,328	72
Panel B. Dropping one state								
Cantabria	0.0574	0.773	15,022	203	0.0579	0.958	11,470	155
País Vasco	0.0557	0.160	13,912	188	0.0545	0.161	10,286	139
La Rioja	0.0577	0.871	14,800	200	0.0588	0.740	11,470	155
Navarra	0.0571	0.755	12,580	170	0.0577	0.949	9,620	130
Castilla y León	0.0580	0.982	13,690	185	0.0608	0.311	10,508	142

Note: All estimations are obtained using the most robust specification of our regression model, outlined in Table 2, column (5). Panel A employs sub-samples of cooperatives categorized according to their size. Panel B we narrowed the sample by excluding one state. In both panels, we keep gas stations that have fully reported prices in the time interval to have a perfectly balanced panel. Standard errors are clustered at the zipcode level.

B.5 Tax pass-though in partially treated states

In this appendix, we estimate the impact of the tax reform on the prices of cooperatives in states where fuel duties saw only minor increases. Specifically, we consider Aragón (with a tax increase of

[28] To mitigate potential attrition bias concerns, as explained in Appendix B.3, the estimates for these sub-samples of cooperative gas stations presented in this table are obtained by including only those that were actively operating throughout the entire period covered by our sample.

Table B.5. The effect of tax reform on diesel and gasoline prices among cooperatives (considering partially treated states)

	(1)	(2)	(3)	(4)	(5)
Panel A. Outcome variable: Diesel price (€/l)					
Tax × *Post*	0.0565***	0.0557***	0.0559***	0.0571***	0.0564***
	(0.00207)	(0.00209)	(0.00180)	(0.00177)	(0.00176)
Tax_{AR} × *Post*	0.0260***	0.0250***	0.0246***	0.0249***	0.0246***
	(0.00222)	(0.00220)	(0.00204)	(0.00198)	(0.00199)
Tax_{EX} × *Post*	0.0112***	0.0103***	0.0102***	0.0104***	0.0106***
	(0.00176)	(0.00173)	(0.00155)	(0.00155)	(0.00158)
R^2	0.331	0.662	0.896	0.904	0.906
P-Value $H_0 = 0.058$	0.470	0.279	0.239	0.613	0.380
P-Value $H_0 = 0.029$ (AR)	0.183	0.0725	0.0309	0.0388	0.0298
P-Value $H_0 = 0.012$ (EX)	0.656	0.323	0.257	0.313	0.388
N. Observations	23,222	23,222	23,222	23,222	23,222
N. Gas Stations	328	328	328	328	328
Panel B. Outcome variable: Gasoline price (€/l)					
Tax × *Post*	0.0611***	0.0601***	0.0597***	0.0604***	0.0590***
	(0.00276)	(0.00260)	(0.00245)	(0.00250)	(0.00250)
Tax_{AR} × *Post*	0.0284***	0.0277***	0.0283***	0.0284***	0.0276***
	(0.00331)	(0.00323)	(0.00288)	(0.00294)	(0.00287)
Tax_{EX} × *Post*	0.0152***	0.0144***	0.0142***	0.0142***	0.0144***
	(0.00345)	(0.00330)	(0.00314)	(0.00314)	(0.00309)
Week FE		✓	✓	✓	✓
Gas Station Characteristics		✓	✓		
Brand Dummies			✓		
Gas Station FE				✓	✓
State×Brent					✓
R^2	0.196	0.695	0.890	0.890	0.895
P-Value $H_0 = 0.058$	0.270	0.413	0.490	0.347	0.693
P-Value $H_0 = 0.029$ (AR)	0.850	0.695	0.798	0.829	0.620
P-Value $H_0 = 0.012$ (EX)	0.362	0.469	0.479	0.488	0.444
N. Observations	16,513	16,513	16,513	16,513	16,513
N. Gas Stations	237	237	237	237	237

Note: The outcomes are diesel prices (Panel A) and unleaded gasoline prices (Panel B), in euros per liter. We add two partially treatment states: Tax_{AR} (Aragón) and Tax_{EX} (Extremadura). We test the null hypothesis of full pass-through of each state in comparison with our control group. It is 2.9 cents for Aragón and 1.2 cents for Extremadura. Column (1): simple *DiD* estimator, controlling for the announcement period (June-December 2018) and its interaction with *Treated*. Column (2): same as the previous column but with *Post* replaced by week-month fixed effects and the addition of control variables at the gas station level. Column (3): same as the previous column but also including brand dummies. Column (4): *TWFE* estimator, including gas station and week-month fixed effects, with no other controls. Column (5): same as the previous column but also including State dummies interacted with the Brent crude oil price. All the point estimates are obtained through OLS, and standard errors are clustered at the zip code level (in parentheses). The significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

2.9 cents per liter) and Extremadura (with an increase of 1.2 cents per liter), which were dropped from the sample used in our empirical analysis in the main text.[29] To do so, we estimate our main regression model by introducing additional dummy variables, each denoting one of these two states, and also the interaction between these two additional dummies and $Post_t$. The results of this empirical analysis are included in Table B.5.

Once again, the point estimates associated with gas stations in these states generally align with a full pass-through of the respective tax changes. Across both panels (using both diesel and unleaded gasoline prices) and all five model specifications included in columns (1) to (5) in Table B.5, we cannot reject the null hypothesis of full pass-through of the tax change into retail prices at the 5% significance level. Only in Aragón, for diesel (Panel A), do some columns show a slight deviation from full pass-through; specifically, columns (3) to (5). In this case, although there is statistical evidence to reject the null hypothesis of full pass-through at the 5% significance level (but not at the 1% significance level), the deviation of full pass-through is relatively small (86% pass-through), with a difference of less than half a cent. Nevertheless, these findings should be interpreted with caution for two main reasons. First, due to concerns about the validity of the *TWFE* and *DiD* estimators in settings with multiple treatments: as explained by De Chaisemartin and d'Haultfoeuille (2023), in such contexts, the estimated coefficients may be incorrect as they capture not only the effect of a particular treatment but also the effects of other treatments. Second, due to the limited sample size in certain states (e.g., in Extremadura there are only 27 cooperative gas stations). Despite this exception and considering these potential caveats, our results are overall consistent once again with the absence of markup adjustment among cooperative gas stations.

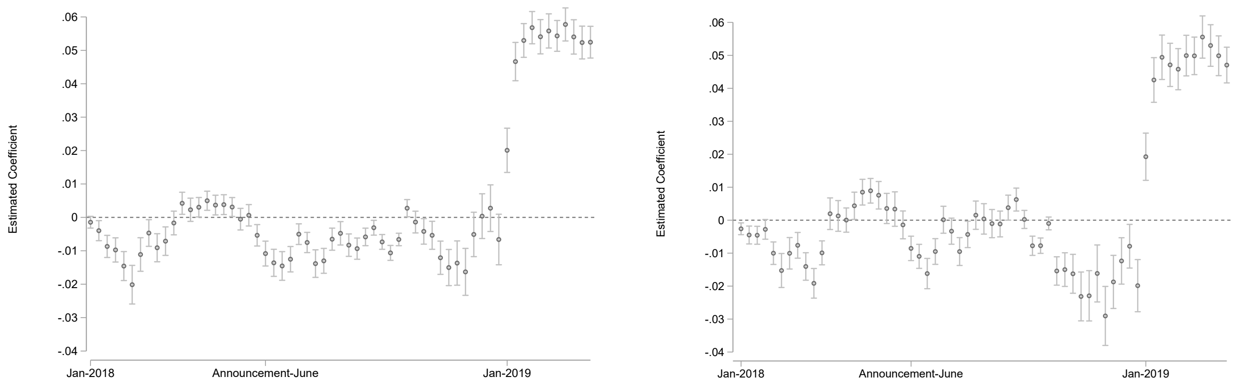
B.6 Extended event-study plots

In Section 5.2, we illustrate in Figure 4 the estimated impact on diesel prices (Panel A) and unleaded gasoline prices (Panel B) on a week-by-week basis. This figure covers the eight weeks before the announcement of the tax reform in June 2018, the announcement week, and the subsequent eight weeks following its implementation in January 2019. However, for the sake of clarity, we excluded estimates of all other leads prior to the reform and for each week from its announcement to implementation. Thus,

[29] There are no cooperative gas stations in the state of Madrid. Additionally, we exclude the state of Asturias from this analysis as it has only three gas stations owned by cooperatives. Furthermore, Asturias experienced a minor increase, of just one cent per liter, which only affected diesel prices but not unleaded gasoline.

for completeness, in this final appendix, we provide Figure B.1, presenting the complete set of point estimates, including all leads since January 2018 (excluding just the first week) and for each week from the announcement to implementation.

Figure B.1. Impact on cooperative diesel and gasoline prices before and after the announcement (full set of weeks) and after the implementation of the tax reform



(A) Diesel **(B)** Gasoline

Note: The figure shows the estimated impact of the January 2019 tax harmonization reform on the prices of diesel (Panel A) and unleaded gasoline (Panel B) for cooperative gas stations before its announcement and after its implementation. The estimates are obtained using the most complete specification of equation (5.1)—used in column (5) in Table 2—, augmented with week-by-week leads and lags dummy variables interacted with Tax_s. Vertical bands represent a 90% confidence interval. Point estimates are displayed since January 2018 for all the weeks before the announcement of the tax reform (excluding the first week), for all the weeks following its announcement, and for up to 8 weeks after its implementation.

The results of this final empirical exercise, using both diesel and gasoline prices, are included in Panels A and B of Figure B.1 respectively. Once again, we observe no evidence of pre-trends in these lead coefficients: all are close to zero. However, some exhibit slight statistical significance (either positive or negative) for both fuels. These minor deviations from zero may be attributed to seasonal patterns and inventory holdings, resulting in slight price fluctuations and adjustments throughout the year (Borenstein and Shepard, 2002; Levin et al., 2017; González and Moral, 2023). Importantly, in both panels, all coefficients post-implementation of the tax change are statistically significant, averaging around 0.055-0.06. These findings not only confirm the absence of differential pricing trends between treated and control groups but also provide further evidence of the tax increase's positive impact on retail fuel prices after January 2019.