Back to Normal? Strategic Pricing After COVID-19 in Retail Gasoline

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Abstract

This paper examines how competitive dynamics shift following demand shocks by studying Peru's gasoline market during and after COVID-19. Using data from Peru's mandatory price reporting system and exploiting Lima's geographic variation in competitive intensity, we employ difference-in-difference and triple difference approaches to identify strategic interactions between major retail chains. Building on Green and Porter (1984) framework of tacit collusion under demand uncertainty and Byrne and De Roos (2019) focal price mechanism, we analyze how firms achieve coordination through price matching after market disruptions.

Our results show that chain stations in premium gasoline markets experienced price decreases of 15-25% relative to independent stations during COVID-19, followed by a return to pre-pandemic relative levels by January 2022. This convergence happened after an increased price matching between competing chain stations, rising from 20% to 60%, which could be hypothesized as a signal to coordinate. Also, we document price cycles consistent with tacit collusion strategies, providing evidence that firms can achieve coordination through price signaling after demand shocks. The contrast between regular and premium gasoline markets indicates that consumer price sensitivity influences the viability of these coordination strategies.

Contents

1 Introduction

The COVID-19 pandemic's impact on gasoline markets provides a unique opportunity to examine how competitive dynamics shift following a major demand shock. This research investigates whether the return to pre-COVID price levels in Peru's gasoline market resulted from normal competition or tacit collusion between companies, with a particular focus on the mechanisms through which firms might achieve coordination without explicit communication.

Our analysis contributes to three interconnected literature streams. The first one is related to the studies of gas station competition, which have established that location critically shapes market dynamics. The second is related to collusion literature, which has struggled to explain how independent firms achieve coordinated outcomes without explicit communication, though recent work suggests firms may reach coordination through trial-and-error price adjustments to find common "focal points". Finally, we also try to give evidence on theoretical work on collusion under demand uncertainty, which suggests that equilibrium outcomes may involve collusion during high-demand periods and competitive pricing during low demand, leading to price cycles and sometimes to price rigidity.

We examine these dynamics using data from Facilito, Peru's mandatory gas price reporting system. Lima's geography creates natural variation in competitive intensity, with dense networks of chain and independent stations in the city center but sparse competition in outer areas. This variation, combined with distinct markets for regular and premium gasoline, allows us to identify the effect of interaction between the two big gas station retailer chains: Repsol and Coesti.

Our empirical strategy exploits two key features of the market. First, we employ a difference-in-difference approach comparing chain stations in high-competition zones to those in low-competition zones. This within-chain comparison controls for chain-specific supply shocks, as both Repsol and Coesti are vertically integrated with their own refineries. Second, we strengthen our identification using a triple difference approach that incorporates independent stations as an additional control group. This addresses potential location-specific shocks during COVID-19 that might confound our difference-in-difference estimates, allowing us to isolate the chain-specific response to the pandemic in competition zones.

The data reveal distinct patterns across fuel types. For regular gasoline, prices between chain and independent stations remained largely aligned throughout the period, showing similar trajectories during both the initial COVID-19 decline and subsequent return to pre-pandemic levels. However, the premium gasoline market exhibited different dynamics. While chain stations historically maintained a 15% price premium over independent stations, this relationship showed significant disruption during the pandemic. Our triple difference estimates reveal that Repsol's stations in competition zones experienced a price decrease of approximately 25% relative to independent stations, while Coesti's decrease was around 15%. By January 2022, these price relationships had returned to their pre-COVID patterns, raising questions about the mechanisms driving this convergence.

Our findings suggest that the return to pre-pandemic price levels, particularly in the premium gasoline market, may have been facilitated by a simple coordination mechanism. We document an increase in exact price matching between competing chain stations, rising from an average of 20% to nearly 60% by July 2021, even when the market factors were pushing the price upwards. This happened just before price-gaps respect to independent gas stations began converging to pre-COVID levels. This pattern is especially pronounced in central Lima, where chain density is highest. Furthermore, we observe distinctive cyclical patterns in price differentials consistent with theoretical predictions of tacit collusion strategies. These results provide great insights for competition policy, particularly regarding how firms might achieve coordination through price signaling after a major market disruption.

2 Literature review

This research examines whether the increase in gasoline prices following Covid-19 resulted from normal competition or from some form of tacit collusion between companies. If collusion played a role, we investigate how companies might have reached this arrangement. Our literature review covers three key areas: how gas stations compete with each other, how companies collude and communicate, and how market balance shifts when demand suddenly changes.

Research on gas station competition shows that location is crucial to understanding how these markets work. Perdiguero and Borrell (2012) finds that distance strongly affects how stations compete with each other, noting that a station's main competition comes from other stations that drivers can reach within 5-6 minutes. Similarly, Byrne (2010) demonstrates that a station's prices are closely linked to those of its 15 nearest competitors.

Gas station markets show large differences in prices and profit margins. Hosken et al. (2008) observes that these variations are significant, and stations' competitive positions can shift dramatically over time. Korff (2021) explains price patterns using Edgeworth cycles, where prices rise as demand increases. Another explanation comes from Hong and Lee (2020), who shows that stations with more market power respond differently to market changes, which might indicate tacit collusion in some markets. Looking at costs, Gautier and Saout (2015) finds that how stations adjust their prices to changes in oil prices depends heavily on local market conditions and individual station decisions.

Asker and Nocke (2021) analyzes multiple collusion cases, highlighting the importance of understanding how these agreements start and how firms maintain them through communication. They point out that tacit collusion remains a weak explanation since it's unclear how independent firms can reach agreements for higher profits without talking to each other. Byrne and De Roos (2019) offers a practical solution to this problem by showing how firms can reach better outcomes through trial and error, testing price increases until they find a common ”focal point” that helps them coordinate.

The analysis of a Canadian gasoline cartel by Clark and Houde (2013) reveals how market asymmetries create pricing dynamics similar to menu cost models, where optimal strategy involves alternating between major and minor price adjustments. This framework introduces instability to cartel operations, as participating firms must balance optimal pricing against agreed-upon price levels. Building on these insights, Clark and Houde (2014) demonstrates that explicit collusive communication led to asymmetric price increases, manifesting this as common cyclical patterns rather than sudden price increases.

In the case of collusion under demand uncertainty, Green and Porter (1984) gives a theoretical foundation to justify the existence of tacit collusion, where the equilibrium is to collude when demand is high and to play non-cooperatively when demand is low, leading to asymmetric price cycles. Athey et al. (2004) explore the possibility of observing price rigidity under the collusive framework, which is feasible if firms are patient enough.

Recent research on algorithmic pricing has expanded our understanding of how price levels and update frequencies serve as competitive signals. Calvano et al. (2021) demonstrate that pricing algorithms can autonomously develop collusive behaviors without explicit programming. Brown and MacKay (2023) examine algorithmic pricing implementation in competitive environments, revealing that price increases can emerge from competitive dynamics rather than collusive intent. The variation in price update frequencies introduces an additional dimension to conventional game-theoretic frameworks, giving new interpretations of observed equilibrium states.

3 Data

The data was sourced from Facilito, a web portal designed to foster competition among Peruvian gas stations. This platform aggregates retail gasoline price information from January 2018 onward. Retailers are required to submit price data and face strong incentives for accurate reporting due to regular inspections. Non-compliance penalties include revocation of authorized supplier purchasing permits, substantial supply cost increases, and operating license suspensions. The database encompasses pricing information across all fuel types: regular gasoline, premium gasoline, diesel, liquefied petroleum gas, and liquefied natural gas. The dataset also includes geographical coordinates and ownership information for each station, enabling analysis of pricing dynamics across independent stations and chain operations.

The dataset presents limitations related to informality, data quality, and scope. First, while cessation of price reporting is interpreted as station closure, limited enforcement may enable some stations to continue operating informally, particularly in non-urban areas. Second, the data requires substantial preprocessing, specifically regarding ownership structures and geographical coordinates, especially for rural locations. However, as our analysis focuses on the Lima region, these data quality concerns are less significant than for other regions. Additionally, the dataset's restriction to price information, without corresponding inventory and sales data, constrains the potential depth of analysis.

4 Empirical strategy

4.1 Difference-in-difference approach

To understand how Covid-19 changed pricing between the two major chains, Repsol and Coesti, we'll focus on areas where their stations compete directly. We can use a difference-in-difference analysis because our data gives us a natural comparison group: chain stations in areas where they don't compete with each other. This comparison is visible in Figure 2, which show station locations.

We compare two scenarios: what really happened during Covid-19, and what might have happened if Repsol and Coesti didn't influence each other's pricing during the pandemic. Table 1 illustrates how we're studying an indirect effect of Covid-19. If the pandemic's impact was the same for all stations, whether they competed with other chain stations or not, our analysis would show no significant effect.

Table 1: Difference and difference design

	Pre-Covid	After Covid
Outside competition zones	Baseline (B)	B + Shock(S)
Inside competition zones	B + Interaction (I)	B + I + S + I $\times$ S

Since we are using stations owned by the same company as controls, the assumption that the estimated effect is clean from supply-side shocks is plausible. Both retailer firms are part of bigger vertical integrated conglomerates, so they buy gasoline from certain oil refineries: Repsol from La Pampilla oil refinery (owned by Repsol), and Coesti from Conchan oil refinery (owned by PetroPeru). As we are focusing the analysis on Lima, all of the other small stations have the same suppliers' offers.

We estimate the following:

$$p_{it} = \sum_t \tau_t + \sum_i \alpha_i + \sum_{\rho=-50}^{200} \beta_\rho \times 1[t = \bar{t} + \rho] \times 1[i \in I] + \epsilon_{it}$$

Where I is the set of stations that belong to the competition zone, i indexes each station, and the parameter of interest is β_ρ. This parameter's values for $\rho < 0$ will help us validate if the parallel trend assumption is plausible in pre-trends. We estimate the model using weekly information. The period $\bar{t}$ is the first week of 2020. In this specification, I am using gas stations owned by chains only.

To avoid potential spill-overs effects, we consider in the control group all stations that are more than 5 km far from any other chain competitor station. We work with actual prices, not logarithms, in our calculations. If we used logarithms, we'd be assuming that prices follow a log-normal pattern, which would undervalue price increases and skew our results.

4.2 Triple difference approach

The parallel trend assumption does play an important role if we want to link the estimated effect to a pure interaction effect. If we consider that there are no other location-specific factors that affect the trend of prices other than Covid-19 and the chain interaction effect, our estimation strategy is plausible. However, if we consider there is a potential effect specific to the locations inside competition zones that happened after Covid-19, like suddenly logistic costs becoming cheaper in those zones or a preference towards quantities than prices for small retailers managers in those zones, our estimates can't be attributed to the interaction. As we can access information on non-chain retailers, we can use their price evolution to correct a potential bias in the parallel trend assumption.

Table 2 shows the logic behind the design. This specification assumes that, if Covid-19 happened, we would have observed a change in the chain's price inside the competition areas of δ if there were no interaction. Under this design, we can think of δ as a baseline of the price change due to a new equilibrium. Therefore, the estimates using this strategy reflect how different the chain's reaction to this new equilibrium is from that of non-chain stations.

Table 2: Triple difference design

		Pre-Covid	After Covid
Non-chains	Outside	B_N	$B_N + S_N$
	Inside	$B_N + I_N$	$B_N + I_N + S_N + \delta$
Chains	Outside	B_C	$B_C + S_C$
	Inside	$B_C + I_C$	$B_C + I_C + S_C + \delta + I_C \times S_C$

We estimate the following specification to get an estimate β_ρ for each period after Covid-19:

$$p_{it} = \sum_t \tau_t + \sum_i \alpha_i + \sum_{\rho=-50}^{200} \delta_\rho \times 1[t = \bar{t} + \rho] \times 1[i \in I] + \sum_{\rho=-50}^{200} \beta_\rho \times 1[t = \bar{t} + \rho] \times 1[i \in I \cap C] + \epsilon_{it}$$

Where I is the set of stations that belong to the competition zone and C is the set of stations that belong to the chain station. Notice that we are using chain and independent stations in this specification.

4.3 Threats to identification

While the triple-difference estimator addresses potential problems due to the magnitude of Covid-19 impact on the equilibrium of the market, the proposed strategy could suffer in identifying the interaction effect due to the endogenous choice of station locations. Since chains choose where to compete, they can choose locations where the demand reacts differently from places where they don't compete. This would imply differentiated price adjustment under high-demand scenarios.

Additionally, our assumption is that the spillover effect of competence is no longer relevant after a 5 km radius of competence, which can be seen as arbitrary. We have picked that distance because it ensures the pre-trends assumption and maximizes the number of observations in the control sample.

A final identified threat to the identification is the potential effect of the existence of interdependence between regular and premium markets that the specification is not taken into account. This would lead to observing prices led by exogenous factors to the original market, which can be correlated among stations. Therefore, we would estimate the effect of those exogenous factors instead of the interaction effect.

5 Results

5.1 A disruption to the market equilibrium: Covid-19

As shown in Figure 1, both regular and premium gasoline prices followed similar patterns: a decrease in 2020 followed by a continuous increase in 2021. For Peru, gasoline prices are mainly influenced by two factors: international oil prices and the exchange rate, as Peru needs to import oil using dollars.

Two types of gasoline dominate Lima's market: regular and premium, both mainly serving private vehicles. As shown in Figure 2, gas station locations follow a clear pattern. The city center has a dense network of stations, with both major chains and independent sellers operating close to each other. In contrast, the outer areas of the city have fewer stations, and the major chains encounter less direct competition there. We use this contrast to examine how stations behave under different competitive pressures and demand levels.

Looking at regular gasoline prices in Figure 3a, we see an interesting pattern. Until 2020, there was little difference between prices at chain stations and independent stations. However, from 2021 onwards, a clear gap emerged as chain stations raised their prices more significantly than independent stations.

Figure 3b shows the price gap patterns for premium gasoline. Even before 2020, chain stations charged notably higher prices than independent stations, with prices about 15% higher. Prices dropped and stayed relatively stable during 2020. Starting in mid-2021, the price difference between chains and independent stations grew substantially and continued to widen until our study ended.

The price changes during Covid-19 - first dropping in 2020, then rising in mid-2021 - shifted the competitive balance between chain stations and their rivals. While this shift was especially clear in premium gasoline prices, we need to better understand what drove these changes. Were chains responding to independent stations' prices, or to each other? I'll examine how Covid-19 influenced prices by looking specifically at how the two major chains, Coesti and Repsol, interacted with each other.

5.2 The chain interaction effect on prices

The difference-in-difference estimator

The difference-in-difference analysis reveals substantial changes in pricing behavior between stations in competition zones versus non-competition zones following the Covid-19 shock. Figure 4 presents these results separately for Repsol and Coesti, examining both regular and premium gasoline.

For regular gasoline, both major chains show evidence of differential pricing behavior in competition zones after Covid-19. Figure 4 shows the results of the difference-in-difference estimator for each week. We observed a non-significant price decrease after the beginning of 2020. Later, after the lockdown, the price decreased by 1.00 PEN (5 % of the counterfactual price) for Repsol and 0.20 PEN for Coesti (1 % of the counterfactual price); however, the former is not significant. We observe a price-stable period between weeks 25 and 75 for both chains. Subsequently, the price rose and reached the previous pre-Covid gap for Repsol, and it was even temporarily higher for Coesti.

The effects are more pronounced in the premium gasoline market. The price drop from 2020 was close to 1.00 PEN (10 % of the counterfactual price) for Repsol and around 0.50 PEN for Coesti (5 % of the counterfactual price). After the lockdown, we observe that Repsol's price decreased by 2.00 PEN (20 % of the counterfactual price), and Coesti's price decreased by 1.00 PEN (10 % of the counterfactual price).

The magnitude and persistence of these effects suggest that Covid-19 may have fundamentally altered the competitive equilibrium in Lima's gasoline market, particularly in zones where major chains compete directly. The larger effects in the premium gasoline market align with theoretical predictions that price increases are more likely to happen in markets with less price-sensitive consumers, which is the case for premium gasoline.

Importantly, these results control for chain-specific supply shocks through our within-chain comparison design. Therefore, the estimated effects cannot be explained by changes in chain-level costs or supply arrangements alone. Instead, they point to a change in the strategic interaction between chains in competition zones following the Covid-19 disruption.

The triple difference estimator

While the difference-in-difference results suggest significant changes in chain pricing behavior, they might be confounded by location-specific shocks during Covid-19. Our triple difference estimation addresses this concern by using independent stations as an additional control group, allowing us to isolate the chain-specific response to Covid-19 in competition zones. The triple difference estimates reveal more robust evidence of strategic pricing adjustments than the difference-in-difference approach.

Several features of the results support the validity of our identification strategy, and it is preferred over using the difference-in-difference approach:

- The parallel trends assumption appears to hold in the pre-Covid period (2018-2019) for both fuel types and both chains, as evidenced by the stable and close-to-zero coefficients before the shock.
- The divergence in pricing behavior begins approximately 3-4 months after the beginning of 2020, which coincided with the lockdown in Peru due to Covid-19, suggesting that the effect emerges as firms adjust to the new market conditions.
- The price differentials show persistence, indicating a change in competitive dynamics rather than a temporary adjustment.

We observe that prices for regular gasoline behave closely to independent retailers. There are some common deviations from this in periods after Covid-19, which rapidly returned to be aligned with the market. In the next section, we will argue that a mechanism could explain this coordinated deviation, but it was unsuccessful. This might be evidence that the regular gasoline market has no strategic response component, and chains just react to the market conditions.

However, the case of the premium gasoline market is different. The estimates are significant for both chain retailers. Repsol's stations in competition zones showed a price decrease of approximately 1.50 PEN (25% of the counterfactual price) relative to independent stations, while Coesti's decrease was around 1.00 PEN (15% of the counterfactual price). We observe that the increase in the gap against independent retailers started around week 75 for both chains (July 2021) and reached the pre-Covid levels around week 100 (January 2022).

5.3 Competitive behavior or implicit collusion?

The empirical analysis reveals an interaction effect between chains in the premium gasoline market. The data demonstrates a price decline coinciding with the beginning of Covid-19, followed by a price-gap stability period and then a gradual increase from July 2021 through January 2022. This pattern may indicate a price adjustment corresponding to increasing demand concurrent with the progressive resumption of regular economic activities post-pandemic. These assumptions would be coherent with differential demand patterns between chain-affiliated and independent gas stations, implying distinct price elasticities and, consequently, differentiated pricing strategies.

Two critical findings cast doubt on this basic demand-driven price increase hypothesis. There is exact price matching among directly competing gas stations preceding the increase of the interaction effect-driven price increases. This observation could be explained by a price signaling phenomenon similar to Byrne and De Roos (2019), where the uses a simple price increase rule to coordinate. Additionally, we observe a cyclical nature of price gaps aligns with collusive patterns, as established by Clark and Houde (2014).

Matching nearby stations prices as focal points

The data reveals a pattern of price coordination that precedes the observed price-gap increases for both chains. Figure 6 shows the proportion of chain stations that exactly match prices with their nearby chain competitor over time. This metric increased significantly around week 75 (July 2021), just before the substantial price-gap increases identified in our triple difference analysis. For premium gasoline, the ratio of matching prices rose from a historical average of about 20% to nearly 60% during this period. A similar pattern emerged in the regular gasoline market. This price matching strategy is even more striking considering that happened in a period where prices were moving consistently upwards, as we can observe in Figure 1, discarding the idea of the matching based on market stability conditions.

This coordination also appears when examining the absolute price differences between stations. Figures 8 demonstrate that even when prices weren't exactly matched, the average absolute price differences between direct competing stations decreased substantially during this period. For premium gasoline, Figure 8c shows that the absolute price difference between Repsol and Coesti stations dropped to near 0.4 PEN in mid-2021 and stayed stable over six months, suggesting a high degree of price alignment between the two major chains.

The geographical dimension of this price matching, illustrated in Figure 9, reveals that the coordination was particularly strong in areas where both chains operated. By January 2021, we observe a few clusters of stations with identical prices, especially in central Lima, where chain density is highest. This pattern changed completely by July 2021, with a lot of stations matching prices, coinciding with the beginning of the sustained price increases identified in our empirical analysis.

This sequence of events, increased price matching followed by coordinated price increases, aligns with the focal point theory proposed by Byrne and De Roos (2019). The exact price matching could serve as a coordination mechanism, allowing chains to signal their pricing intentions without explicit communication.

While similar price-matching attempts occurred in the regular gasoline market, as we have seen in Figure 6, they were less successful in establishing sustained coordination price-gap increases. This difference in outcomes between regular and premium gasoline markets could reflect the different competitive dynamics in these segments, with regular gasoline facing more intense competition from independent stations and more price-sensitive consumers.

Price cycle patterns

Beyond the initial price-matching behavior, the data reveals distinctive cyclical patterns in price differentials that warrant closer examination. Figure 11 shows the smoothed price gaps between chain and independent stations over time, exhibiting patterns that align with theoretical predictions of explicit collusion strategies described by Clark and Houde (2014).

For premium gasoline, we observe cyclical fluctuations in the price gap following the coordination period that began in July 2021. The amplitude of these cycles is substantial, with price gaps varying by up to 0.5 PEN within each cycle. This pattern is particularly notable because it emerged only after the period of exact price matching identified in the previous section, suggesting an evolution in coordination strategies.

In contrast, the regular gasoline market shows much less pronounced cyclical behavior. While some minor fluctuations are visible, they lack the regularity and amplitude seen in the premium market. The price gaps remain relatively stable and smaller in magnitude, typically varying by less than 0.2 PEN.

This difference between regular and premium markets further supports our earlier findings about the distinct competitive dynamics in these two segments. The cyclical pattern observed in premium gasoline prices is consistent with Clark and Houde (2014) findings on collusive behavior in gasoline markets.

In their framework, these cycles serve multiple purposes: they help maintain coordination by providing regular opportunities to signal a commitment to the implicit agreement, they make it easier to detect deviations, and they help disguise the coordinated nature of price increases by making them appear more ”natural” or market-driven.

This cyclical behavior, combined with the price matching patterns discussed earlier, provides compelling evidence that the post-Covid price increases in the premium gasoline market may have been facilitated by tacit coordination between the major chains rather than purely competitive responses to changing market conditions.

A theoretical interpretation: a first approach

In this section, I develop a theoretical explanation for the patterns we have observed in the estimation. I'll propose a model in the spirit of Green and Porter (1984).

Let's assume we have two firms indexed by $i \in \{a, b\}$. Each period they set a price p_{it}, for which they make a profit of $\pi_i(p_{it}, p_{-it}, y_t, \epsilon_{it})$. y_t is an indicator of a common shock for both firms, and ϵ_{it} a specific firm shock. The firms can observe the other prices and y_t every period. The variable y_t is random and can be interpreted as an aggregated shock.

To better describe the equilibrium, we define a coordination state s_t that depends on the price history. If the price between firms is equal at any period t, they start the coordination period on the next period. After the coordination period ends, the firm deviates from this matching price strategy; each firm can maximize benefits constrained to set the price higher than the last price in the coordination period.

$$s_t = \begin{cases} C & , p_{it-1} = p_{-it-1} \\ S & , p_{it-1} \neq p_{-it-1}, \forall i : p_{it-1} > p_{ct-1} \\ D & , \exists i : p_{it-1} < p_{ct-1} \end{cases}$$

Notice that we are allowing coordination to start again after a deviation period happens.

The following rule sets the lower price under coordination:

$$p_{ct} = \begin{cases} C & , p_{it-1} = p_{-it-1} \\ S & , p_{it-1} \neq p_{-it-1}, \forall i : p_{it-1} > p_{ct-1} \\ D & , \exists i : p_{it-1} < p_{ct-1} \end{cases}$$

Each firm has to decide on a price strategy, which, in equilibrium, would solve the following:

$$\begin{aligned} p^\star_{it} &= argmax_{p_{it}} \Pi_i(s_t, p_{ct}, y_t, \epsilon_{it}) \\ &= argmax_{p_{it}} \pi_i(p_{it}, p^\star_{-it}, y_t, \epsilon_{it}) + \beta E_t[\Pi_i(s_{t+1}, p_{ct+1}, y_{t+1}, \epsilon_{it+1})] \end{aligned}$$

This model structure could be generalized by considering another coordination mechanism, like s_t, depending on price variation instead of price levels.

We could focus on strongly symmetric equilibrium, which transforms finding the solution into a fixed point problem. Abreu et al. (1986) and Athey et al. (2004) apply similar strategies to explore this type of equilibrium. One of the latter results shows that price rigidity is possible under this setup, which could relate to the price-matching strategy that we observed in our empirical findings.

6 Conclusions and next steps

This research examines competitive dynamic shifts in gasoline markets after a major demand shock and identifies potential coordination mechanisms through analysis of Peru's gasoline market during and after COVID-19.

We document price adjustment pattern differences between regular and premium gasoline markets. While regular gasoline prices remained competitive throughout the period, the premium gasoline market showed evidence of strategic pricing behavior in zones where major chains compete. Our triple difference estimates reveal that Repsol's stations in competition zones had a price decrease of 25% relative to independent stations during COVID-19, while Coesti's decrease was 15%. By January 2022, these price relationships had returned to their pre-COVID patterns.

We identify a potential coordination mechanism through which chains achieved price alignment without communication. From July 2021, we observe an increase in exact price matching between competing chain stations, rising from a 20% average to 60%. This price matching preceded the convergence of chain-independent price gaps to pre-COVID levels, suggesting its role as a focal point for coordination.

We find evidence of price differential cycles after the coordination period in the premium gasoline market. These cycles, marked by fluctuations in price gaps up to 0.5 PEN, align with predictions of tacit collusion strategies and prior findings on explicit collusion in gasoline markets.

The contrasting outcomes between regular and premium gasoline markets provide insights into conditions that facilitate coordination. The establishment of higher prices in the premium market, where consumers show less price sensitivity, compared to failed attempts in the regular gasoline market, suggests market characteristics determine the viability of tacit coordination strategies.

These findings have implications for competition policy. The identification of mechanisms – such as exact price matching and price cycles – provides insights for regulatory monitoring and enforcement.

There are two branches to develop from the current work. The first one is to simulate the theoretical model presented in Section 5.3 and use it to interpret the empirical results since we only have used a previous result to infer the existence of price rigidity. The second is to propose a structural strategy in the spirit of Slade (1992) to estimate a reaction function between chain price policies and propose a formal test to check whether the observed patterns are coherent with competence or collusion.

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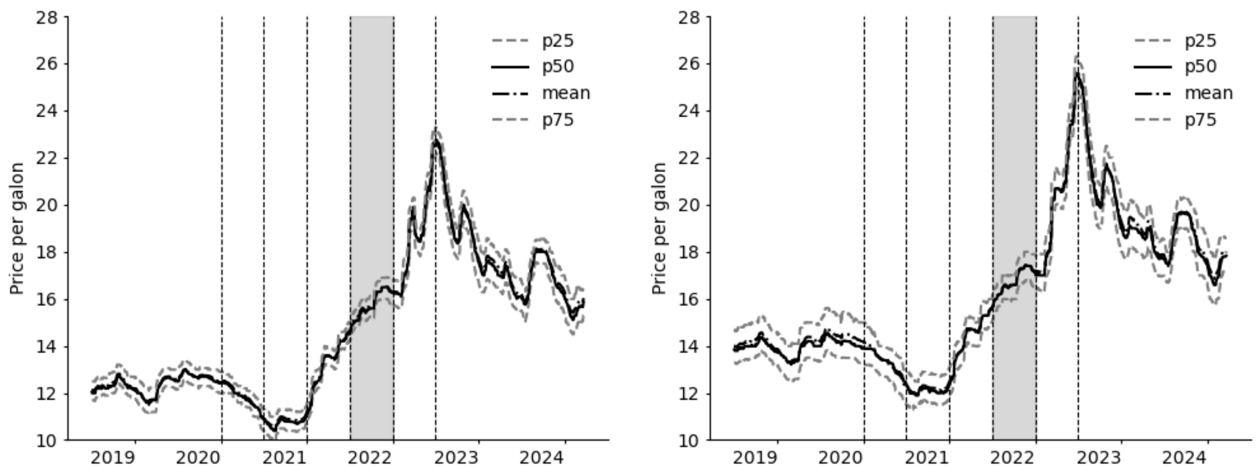
Figure 1: Gasoline price trend



(a) Regular

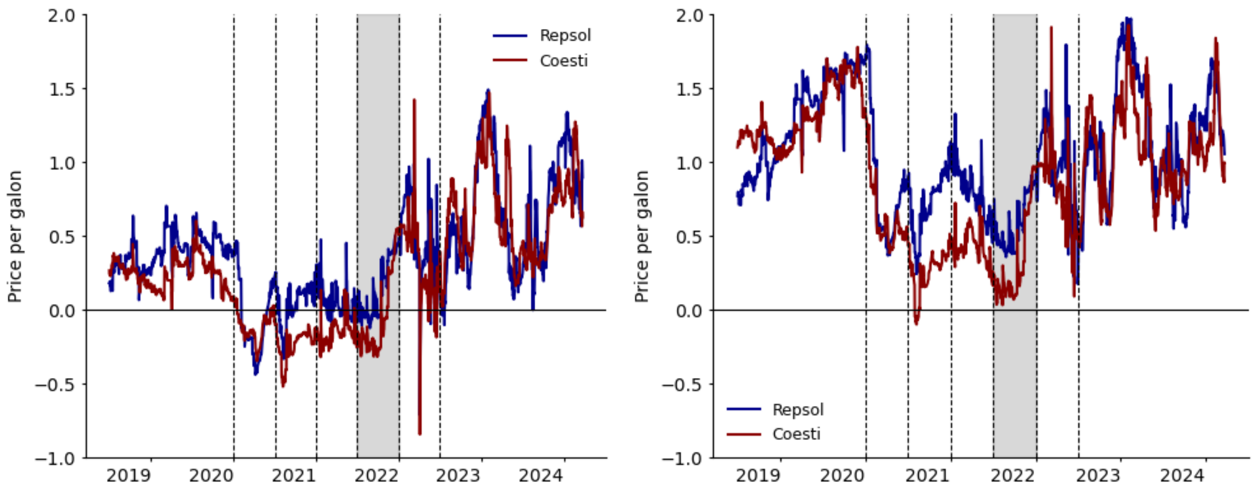
(b) Premium

Note: These graphs illustrate the weekly average gasoline prices across all stations in Lima, measured in Peruvian Soles (PEN) per gallon. The averages are computed from daily price reports submitted by stations to the Facilito platform. The data encompasses both chain-affiliated and independent stations. The averaging process first calculates daily means for each station to account for intra-day price changes, then aggregates these to weekly values.

Figure 2: Gas stations location

Note: This map visualizes the spatial distribution of gasoline stations throughout Lima, with distinct markers differentiating between chain-affiliated stations and independent operators. Zones marked as both have the presence of the two chains as direct competitors.

Figure 3: Average price for chains



(a) Regular (b) Premium

Note: Shows price gaps between chain and independent stations. Calculated as (Chain Price - Independent Price).

Table 3: Repsol and direct competitors statistics - Regular gasoline

		Pre-Covid		After Covid	
		Outside	Inside	Outside	Inside
Non-chains stations	# owners	7	54	7	58
	# station	7	60	7	66
	Price - mean	12.30	12.50	15.75	15.61
	Price - std	0.67	0.75	3.32	3.48
	Price - range	0.7	1	5.75	5.74
Repsol	# owners	1	1	1	1
	# station	3	35	3	37
	Price - mean	12.41	12.88	15.69	15.91
	Price - std	0.56	0.75	3.36	3.67
	Price - range	0.62	1.11	6.25	6.54

Table 4: Coesti and direct competitors statistics - Regular gasoline

		Pre-Covid		After Covid	
		Outside	Inside	Outside	Inside
Non-chains stations	# owners	16	47	19	50
	# station	16	52	19	56
	Price - mean	12.54	12.42	15.59	15.53
	Price - std	1.00	0.78	3.34	3.43
	Price - range	1.10	1.07	5.32	5.79
Coesti	# owners	1	1	1	1
	# station	7	32	7	32
	Price - mean	12.24	12.80	15.45	15.85
	Price - std	0.82	0.71	3.28	3.58
	Price - range	1.20	1	5.62	6.20

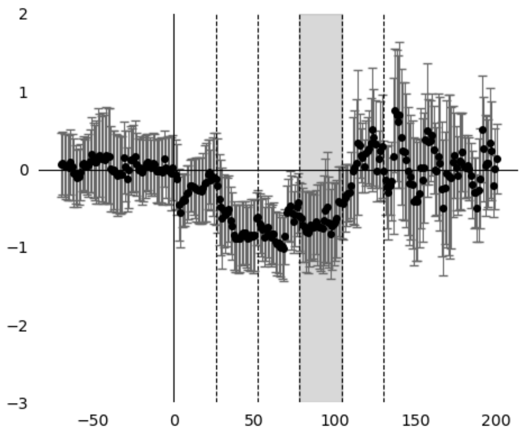
Table 5: Repsol and direct competitors statistics - Premium gasoline

		Pre-Covid		After Covid	
		Outside	Inside	Outside	Inside
Non-chains stations	# owners	7	54	7	58
	# station	7	60	7	66
	Price - mean	13.90	14.48	17.23	17.17
	Price - std	0.54	1.19	3.48	3.79
	Price - range	0.71	1.70	5.40	5.80
Repsol	# owners	1	1	1	1
	# station	3	35	3	37
	Price - mean	14.29	15.51	17.50	17.90
	Price - std	0.79	1.13	3.32	3.93
	Price - range	0.87	1.80	5.15	6.64

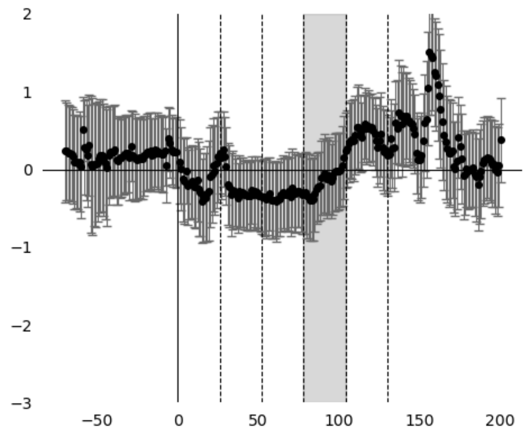
Table 6: Coesti and direct competitors statistics - Premium gasoline

		Pre-Covid		After Covid	
		Outside	Inside	Outside	Inside
Non-chains stations	# owners	16	47	19	50
	# station	16	52	19	56
	Price - mean	13.78	14.41	16.74	17.17
	Price - std	1.04	1.08	3.66	3.67
	Price - range	1.21	1.38	5.74	5.78
Coesti	# owners	1	1	1	1
	# station	7	32	7	32
	Price - mean	13.95	15.54	16.82	17.79
	Price - std	1.20	1.01	3.44	3.84
	Price - range	1.99	1.36	5.56	6.40

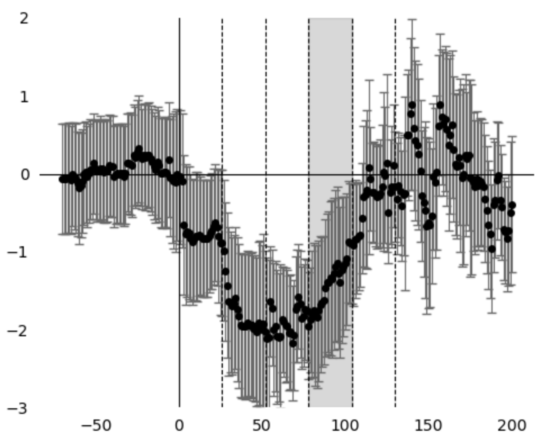
Figure 4: Difference-in-difference estimates



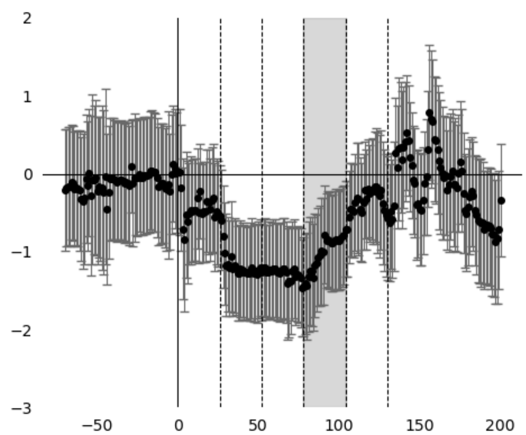
(a) Repsol - Regular



(b) Coesti - Regular



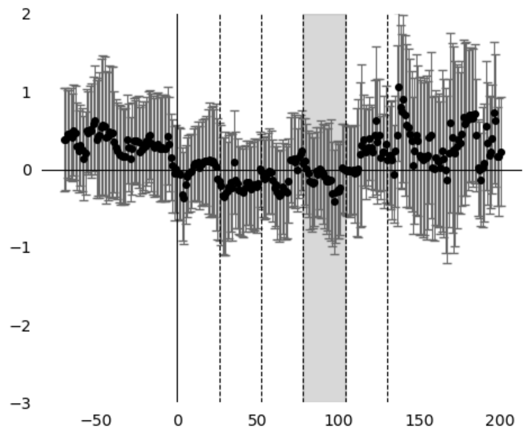
(c) Repsol - Premium



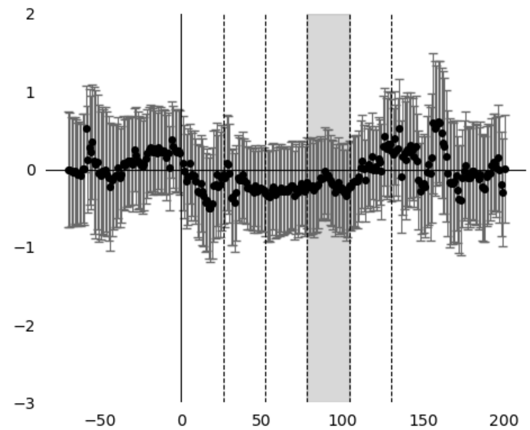
(d) Coesti - Premium

Note: Difference-in-difference estimates comparing chain station prices in competition zones versus non-competition zones. Week 0 is January 2020. Shaded areas show 95% confidence intervals with standard errors.

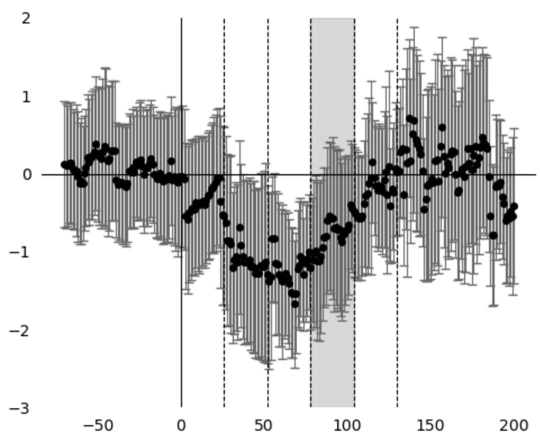
Figure 5: Triple difference estimates



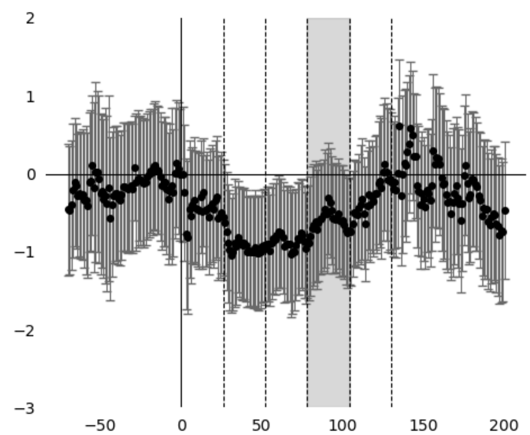
(a) Repsol - Regular



(b) Coesti - Regular



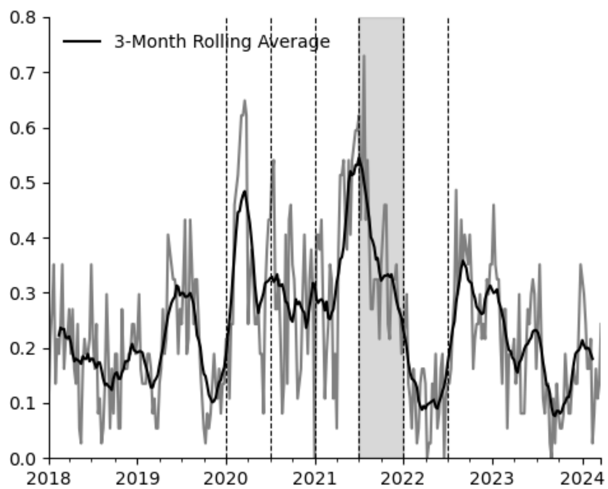
(c) Repsol - Premium



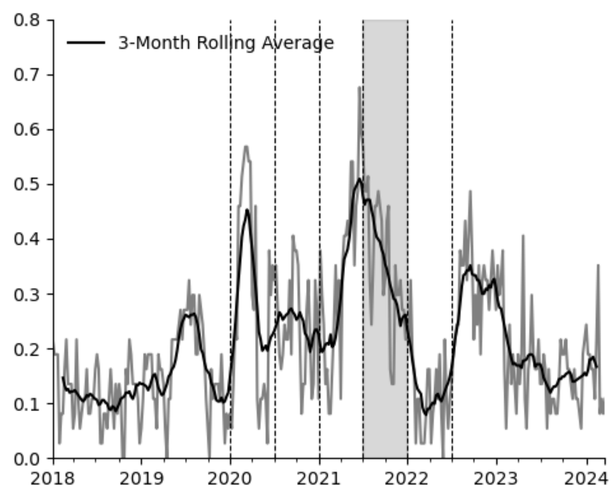
(d) Coesti - Premium

Note: Triple difference estimates showing COVID-19's effect on chain stations in competition zones, using independent stations as additional controls. Week 0 is January 2020. Shaded areas show 95% confidence intervals

Figure 6: Ratio of chains' nearby stations with the same price



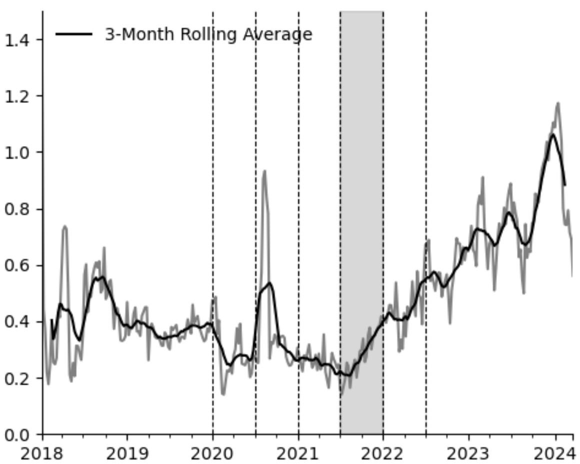
(a) Regular



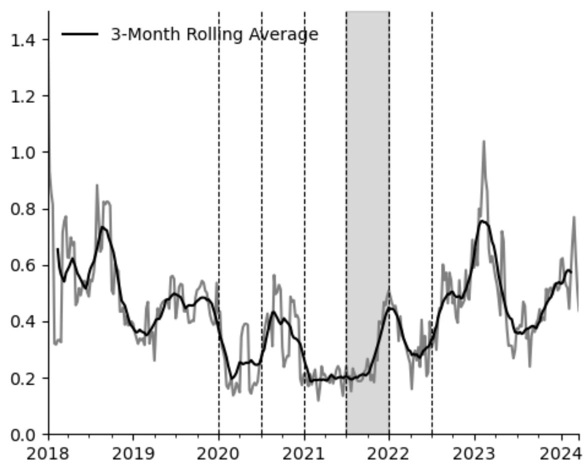
(b) Premium

Note: Shows the percentage of chain stations matching prices with nearby competitors. Prices are considered matched if within 0.01 PEN. Computed weekly, considering that the price matched if at least one day within the week the prices were matched.

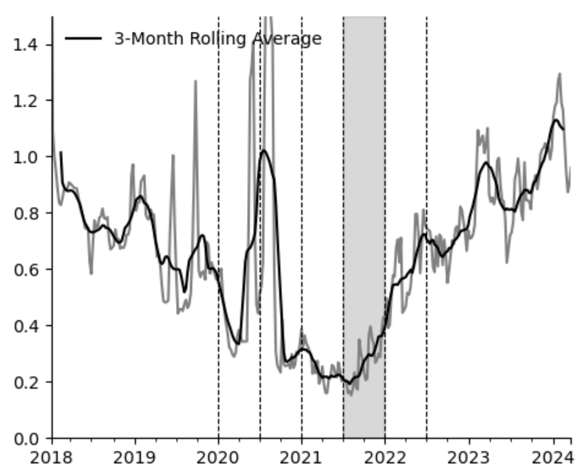
Figure 7: Average absolute price difference - Regular Gasoline



(a) Repsol against competitors



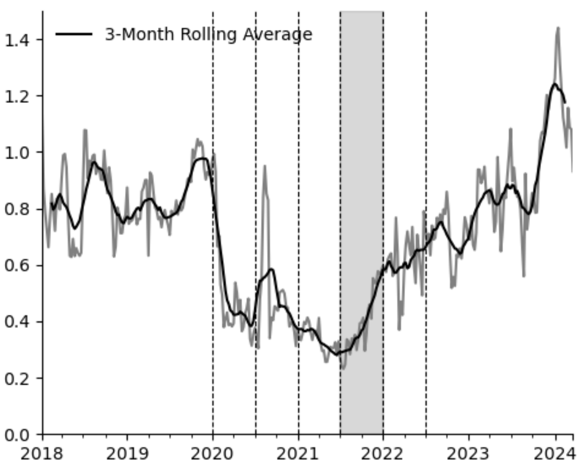
(b) Coesti against competitors



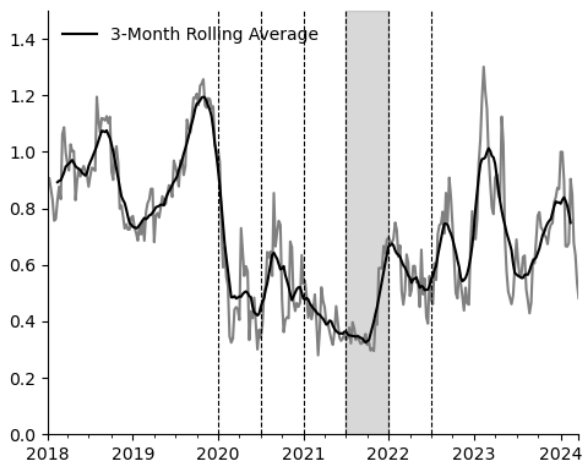
(c) Repsol against Coesti

Note: Shows average absolute price differences between stations in competition zones. Calculated for all stations competing directly. Daily differences are aggregated to weekly values.

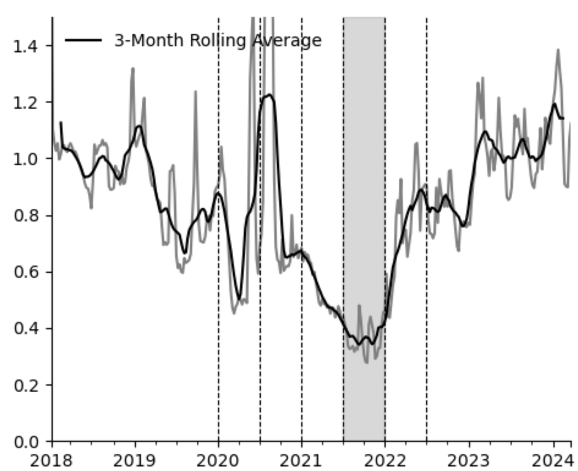
Figure 8: Average absolute price difference - Premium gasoline



(a) Repsol against competitors



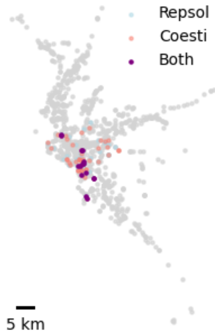
(b) Coesti against competitors



(c) Repsol against Coesti

Note: Shows average absolute price differences between stations in competition zones. Calculated for all stations competing directly. Daily differences are aggregated to weekly values.

Figure 9: Stations with the same price - Regular gasoline



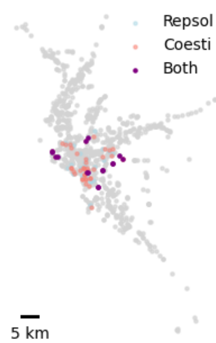
(a) Jan-2020

(b) Mar-2020

(c) Jul-2020

(d) Jan-2021

(e) Jul-2021



(f) Jan-2022

Note: Geographic visualization of stations with matching prices (within 0.01 PEN) in competition zones. Pruple markers indicate matching prices. Shows spatial evolution of price coordination over time in high-density areas.

Figure 10: Stations with the same price - Premium gasoline

(a) Jan-2020

(b) Mar-2020

(c) Jul-2020

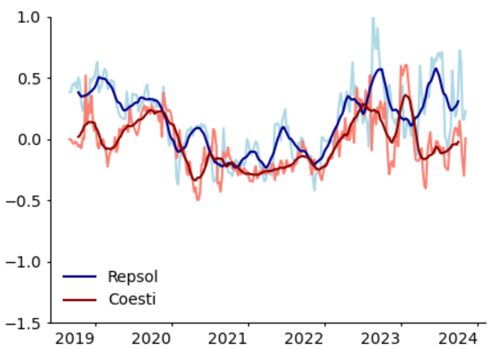
(d) Jan-2021

(e) Jul-2021

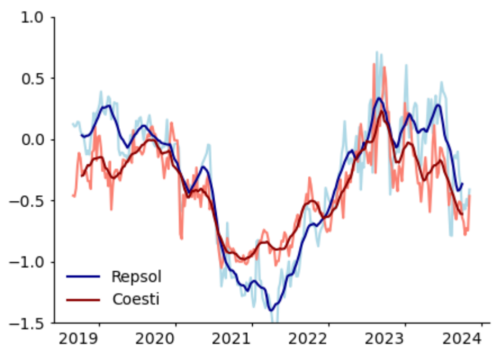
(f) Jan-2022

Note: Geographic visualization of stations with matching prices (within 0.01 PEN) in competition zones. Pruple markers indicate matching prices. Shows spatial evolution of price coordination over time in high-density areas.

Figure 11: Smoothed price gaps



(a) Regular



(b) Premium

Note: Shows smoothed price gaps between chain and independent stations from the third-difference estimates. Smoothed with a 4-week moving average. Separated by fuel type to highlight market segment differences.