The Inner Workings of a Hub-and-Spoke Cartel in the Automotive Fuel Industry

By Daniel Chaves and Marco Duarte*

We analyze a hub-and-spoke cartel in the Brazilian automotive fuel industry. Using the court documents and detailed data on the supply chain we uncover the mechanisms used by gas stations and fuel distributors to solve the obstacles of price coordination. The evidence shows that a subset of distributors (hub) helped the stations (spokes) to overcome coordination problems in three ways: (i) allowing for transfers between geographically dispersed stations (ii) punishing defectors by offering wholesale price discounts to the defector's close competitors; and (iii) reducing the frequency of price changes and asymmetries between stations by diverging sales to the product with stable costs. We argue that the hub benefited from the cartel by being the exclusive supplier during the scheme. We use the synthetic control approach to quantify how successful the cartel was in generating higher mark-ups. We find that not only retailers, but wholesalers benefited from the cartel.

In November 2015, the Brazilian Competition Bureau and the police launched an operation to investigate an alleged cartel in the fuel market of Brazil's federal capital. The police seized documents and arrested gas station owners and managers from fuel distribution companies. The documents and affidavits obtained by the investigation uncovered evidence that gas stations (downstream firms) and fuel distributors (upstream firms) *conspired together* to fix retail prices.[1]

* Chaves: Department of Economics, Western University; dchaves6@uwo.ca. Duarte: Department of Economics, University of Wisconsin-Madison; duartefilho@wisc.edu.

[1] **Legal disclaimer:** This paper analyzes the alleged cartel in Brazil's Federal District from an economic standpoint. Our understanding is based on the documents that are available at the district attorney's website and industry data. These documents provide a legal opinion. All the parts involved are innocent until proven guilty.

Collusive arrangements in which an upstream supplier or downstream buyer help firms in another level of the supply chain to coordinate on market outcomes are called hub-and-spoke collusion. Antitrust authorities have prosecuted cases of hub-and-spoke cartels in a variety of industries (Harrington Jr, 2018). But due to the secretive nature of collusion, the confidentiality involving cases that are prosecuted, and the scarcity of data about vertical practices, little is known to researchers regarding the strategies implemented by firms to sustain a hub-and-spoke cartel. In fact, given that firms have incentives to avoid double marginalization, it is not even clear that upstream firms benefit from such collusive practices.

In this paper, we characterize the strategies used by gas stations and fuel distributors to fix retail prices and we quantify the rents obtained by firms in each level of the supply chain. To this end, we built a detailed data set with information on prices and quantities for both retail and wholesale. We complement the data with the documents produced by the investigation – wiretaps, text messages, emails, affidavits, plea bargain deal and internal documents produced by members of the cartel – that explain the inner workings of the cartel.

Retailers buy ethanol and gasoline - in Brazil these are competing products - from distributors and sell them to consumers. Despite selling homogeneous products, asymmetries across retailers exist. Differences in location impact the distance to consumers and generate geographical differentiation between stations. In addition, retailers have different storage capacities and face different vertical arrangements which lead to heterogeneity in costs. In this setting, a cartel must overcome a number of obstacles. First, the presence of asymmetric firms exacerbates enforcement and coordination problems faced by the cartel.[2] Second, members need to monitor the price setting and punish those that deviate from the agreement. Third, the cartel must be able to deal with cost fluctuations,

[2]For example, less geographically differentiated stations can have larger incentives to deviated from the collusive price than more differentiated ones.

which require frequent price changes and increase the likelihood of detection.

Our first contribution is to show that not only the spokes overcame the difficulties involved in colluding, but that the hub benefited from the spokes coordination. Using a synthetic control approach, we quantify the overprice charged by the cartel and the gains obtained by the gas stations and the distributors. We find that relative to the synthetic control group, the cartel increased retail and wholesale prices by 7 cents per liter and 9 cents per liter, respectively. The overprice translates into a sizeable increase in markups (Lerner index). Retailers sustained an average markup 2.2 p.p. above the 12.5% average markup observed in the synthetic control group. Distributors sustained an average markup 3.2 p.p. above the 5% average markup observed in the synthetic control group.

Our second contribution is to provide a rationale for why distributors would have helped stations to collude in this case. Building on Asker and Bar-Isaac (2014), we argue that distributors help stations cartelize in order to sustain their upstream dominant position. By leveraging on their dominant position and vertical relations, distributors are able to transfer part of the industry excessive rents to gas stations. To maintain those rents, gas stations are willing to exclude potential rivals upstream. However, instead of the usual vertical restraints that Asker and Bar-Isaac (2014) focus on, such as resale-price-maintenance, transfers are implemented by helping downstream firms to collude. Our argument is corroborated by the large decrease in the market-share of the dominant upstream players after the cartel broke.

Our third contribution is to uncover how the three largest upstream firms helped retailers overcome the obstacles to collusion. The documents produced by the investigation and the data analysis show that fuel distributors (i) gave members of the cartel wholesale price discounts during episodes of price wars, (ii) raised the wholesale price of ethanol, and (iii) set wholesale prices according to geographical differences in product differentiation. These actions helped the retail price coordination in different ways. First, wholesale price discounts for stations that were

not responsible for initiating a price war provide a clear benefit to enforce punishment. Second, the price of ethanol is more volatile than the price of gasoline at the production stage. By raising the wholesale price of ethanol distributors diverted consumers to purchase gasoline. Doing so reduces the need of frequent changes on the coordinated price and reduces cost asymmetries between stations. Lastly, geographical wholesale price discrimination can mitigate asymmetries in the stations' incentive to deviate from the accorded price, which allows the cartel to sustain higher prices under an uniform price strategy.[3]

This paper adds to different streams of the Industrial Organization and Antitrust literature. We add to an incipient theoretical and empirical literature that explains the incentives involved in a hub-and-spoke cartel. Sahuguet and Walckiers (2017) show how downstream firms can sustain collusion by sharing demand shock information with each other through the upstream firm. The upstream benefits from this information sharing by being able to charge higher wholesale prices when demand is high. In Van Cayseele and Miegielsen (2013) one supplier and two buyers bargain over a transfer price after the supplier decides if it wants to sell to one or both buyers. The supplier helps buyers to collude on the resale price by refusing to supply buyers that deviate from the collusive agreement. The hub can benefit from a downstream coordination because it increases the transfer price it is able to negotiate. In this article we present channels through which the hub can help collusion between the spokes beyond information sharing or refusal to supply.

On the empirical literature, Harrington Jr (2018) presents an overview of nine different cases where either a buyer or a supplier facilitated collusion between competitors. Asker and Hemphill (2020) is a historical example of a hub-and-spoke arrangement between suppliers and buyers on the Canadian and US sugar industry in the late 1880s. Clark, Horstmann and Houde (2020) is a recent work

[3]This last point is studied in depth on a companion paper, Chaves and Duarte (2021)

on a two-sided hub-and-spoke collusion in the Canadian bread industry.[4] We contribute to the empirical literature with a detailed description of a hub-and-spoke cartel using finer level data on all players in the supply chain. Different from other papers, we are able to characterize the strategies used by the hub and the spokes and to quantify the rents accrued by firms in both levels of the supply chain.

We also add to the literature studying the internal organization of cartels. Despite the vast theoretical knowledge on market features that facilitate cartel stability, the secretive nature of cartels and the confidentiality involved in the prosecuted cases impose limitations on what researchers know in practice (Levenstein and Suslow, 2012). A few exceptions are Genesove and Mullin (2001); Röller and Steen (2006); Asker (2010); Clark and Houde (2013, 2014); Igami and Sugaya (2021). Among these, Clark and Houde (2013, 2014) are the most similar to ours. Although horizontal transfers are also present in our setting, we depart from them by pointing out the role of vertical transfer in stabilizing downstream price coordination.

This article is organized in seven sections. The next section describes the institutional details of the Brazilian automotive fuel industry. In section II we describe the legal case and our data sources. Section III starts with a comparison between the Federal District fuel market and other fuel markets in the country, and ends with a description of the players involved in the scheme. In section IV we quantify the overprice charged by the cartel, and leverage on the fine level of our data to discriminate the gains between retailers and wholesalers. In section V we argue on why distributors helped retailers to collude. In section VI we present evidence on the mechanisms used by the distributors to help stabilise the collusion between stations. In the last section we present our conclusions.

[4] In Clark, Horstmann and Houde (2020) both upstream and downstream helped to soft competition in the other level of the supply chain.

I. The Brazilian automotive fuel industry

Three features of the Brazilian automotive fuel industry are markedly different from the automotive fuel industry worldwide: (i) both gasoline and ethanol are the main fuel alternatives; (ii) the presence of a state-owned monopolist in the oil refinement stage; and (iii) the prohibition of vertical integration between distribution and retail.[5]

Most automobiles in Brazil either run on gasoline or are bifuel (run with gasoline, ethanol or any combination of both). Ethanol became an option to Brazilian consumers in the 1970's as a result of a government program called *Proalcool*. *Proalcool* was a response from the Brazilian government to the first oil shock in the mid 1970's and was designed to reduce the countries' dependence of imported oil. Ethanol consumption surged in the 1980's as most of the cars sold during that decade ran on ethanol but declined during the 1990's as the price of oil declined and the price of sugar increased. With the adoption of the bifuel technology by automobile manufacturers in 2003 and its fast proliferation, 94% of the new cars sold in 2015 were bifuel, ethanol regained its importance.

Figure 1 provides a depiction of the three levels that compose the automotive fuel supply chain in Brazil: production; distribution; and retail. In the production stage, the state-owned monopolist, Petrobras, refines domestic and imported oil to produce more than 90% of the gasoline sold in Brazil.[6] Petrobras sells its production to distributors through 36 different supply points located across the Brazilian territory. Officially, Petrobras has been free to set prices since the early 2000's. However, until the end of 2016, the price Petrobras' charged distributors was being regulated by the federal government. The government used Petrobras to absorb shocks coming from the international oil price and smooth domestic

[5] In most countries, consumers have the option to buy automobiles that run on gasoline or diesel. In Brazil, the only vehicles that run on diesel and have access to the retail network are pick-up trucks. Since these vehicles account for a small fraction of consumers, we choose not to address the retail sales of diesel in this work. The share of vehicles sold in 2015 that runs on diesel was 1.3% (Anfavea, 2019).

[6] The stated-owned monopoly in the refinement is a remnant of dictatorship movements and industrialization policy during the 20th century.

fuel price changes. In contrast, the production of ethanol is marked by small private distilleries dispersed across the country and buying sugar cane from local producers. The ethanol price in the production stage fluctuates with the sugar cane harvest season and the international sugar price. All the tax charged from the supply chain is collected in the production stage.

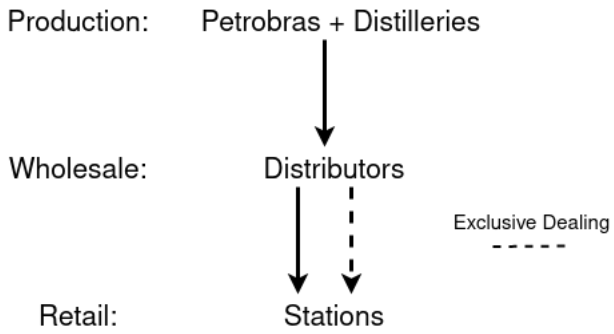


FIGURE 1. AUTOMOTIVE FUEL INDUSTRY SUPPLY CHAIN

Distributors buy gasoline at Petrobras' supply points and ethanol from the private distilleries, and stock them into private tanks.[7] Regulation mandates distributors to mix the pure gasoline with ethanol on a fixed proportion of one liter of ethanol for three liters of gasoline. Distributors then sell and deliver the gasoline and ethanol to geographically dispersed gas stations based on buying orders initiated by the stations. Since 2011 the distribution stage is characterized by a large concentration of sales between three firms: BR, Ipiranga and Raizen. They account for approximately 75% of gasoline distribution and have storage tanks on virtually all the states.[8]

Almost every station in Brazil sells both ethanol and gasoline. Law mandates that stations can only buy fuel from distributors. There is no national player that owns a chain of stations. They are usually owned by local entrepreneurs from

[7] Although distributors can import refined gasoline abroad, imports never accounted for more than 10% of the gasoline sold in the country.

[8] Although Petrobras has 51% of BR's stocks, there are no indications of political influence in BR's price setting behavior. Based on conversations with insiders, the degrees of freedom that BR's regional managers have while setting prices is similar to Ipiranga and Raizen's.

each city. Regulation prohibits distributors to operate gas stations, but allow them to sign exclusive dealing contracts with each station.[9] A standard exclusive dealing contract mandates the gas station to buy only from the distributor it signed the contract with and determines a minimum quantity that must be bought during the contract period.[10] While the exclusive dealing is in place, the station benefits from the use of the distributor's brand and advertisement campaigns. Stations that do not have exclusive dealing contracts are free to buy fuel from any distributor. However, they cannot use the distributor brand to promote sales or somehow characterize the station. Throughout this work we refer to stations without exclusive dealing contracts as unbranded stations and the ones with exclusive dealing as branded stations.

II. The Investigation and Legal Charges

Brazil's Federal District is composed by the federal capital, Brasilia, and a set of neighboring cities, defined as Administrative Regions. Brasilia was planned and constructed by the state during the 1950's in the midwest region of the country. The Administrative Regions grew and developed as people migrated to the Federal District. In 2010, Brasilia and the Administrative Regions had a population of 4.2 million people. Since they form a single urban area and have the same administrative body, we treat the Federal District as a single market.

In 2011, the Brazilian Regulatory Agency of Petroleum, Natural Gas and Biofuel (*ANP* hereafter) informed the district attorney office about an uncommon co-movement in the price of gasoline across gas stations in the Federal District.[11] With this information, the district attorney office, the police, and the Brazilian antitrust authority started to investigate possible collusive practices in the indus-

[9] The law against vertical integration was created during the liberalization of the sector at the end of the 90s, with the intention to sustain competition along the supply chain.

[10] The length of the contract usually varies depending on how much the distributor helped financing the construction of the gas station, but according to conversation with insiders it average around 5 years.

[11] We use *district attorney office* as a translation for *Ministério Público do Distrito Federal e Territórios*.

try. The investigators wiretapped station owners and distributors' sales representatives during the year of 2015. After the police gathered enough evidence of wrong doing, a judge issued search and arrest warrants in November 2015.

The police investigation uncovered evidence that starting at some point between 2010 and 2011, gas stations and fuel distributors conspired together to fix gasoline and ethanol retail prices. In the beginning of the agreement, stations used the trade association meetings to determine the price the cartel would charge. As the scheme evolved, the largest retail chain operating in the Federal District, Cascol, consolidated as a leader in the decision and coordination of the retail price changes.[12] Furthermore, records of frequent conversations between distributors' managers and gas stations owners about the cartel details show that the three largest fuel distributors – BR, Ipiranga and Raizen - were active members in the conspiracy.

The conspiracy did not end with the arrest of cartel members in November 2015. Police monitoring indicated that gas stations fixed retail prices until January 2016. The resilience of the price fixing arrangement led the antitrust authority to intervene in the market by replacing the management from Cascol with a government appointee in February 2016. The goal of the appointee was to keep the largest retail chain operational while seizing any collusive practice.

During the legal process a number of cartel members accepted the plea bargain deals offered by the antitrust authority. At the end, the District Attorney's office brought charges against 28 individuals: 16 station owners, 6 stations employees, and 6 distributors employees. It also requested the payment of approximately $266 million dollars in damages.[13] The charges were based on the material obtained by the police - wiretapped conversations, documents and depositions - and on the plea bargain deals.

The documents seized by investigators together with the defendants testimonies

[12]Two excerpts of the affidavit corroborating this point can be found in quote 3 and quote 4 in appendix E

[13]This figure was obtained using the 2018 exchange rate.

are our main source of data regarding the inner workings of the cartel.[14] We complement the documents with detailed data on the Brazilian fuel market provided by ANP, ESALQ (an energy sector think-tank), Petrobras and the Minister of Transportation. The dataset covers every link of the supply chain and has information on prices, stations characteristics, location and volume of fuel purchased by gas stations. Most of the data is available for the Federal District and all the state capitals since 2007. A detailed description of it is presented in appendix B.

III. The Federal District Fuel Market

In this section we contrast features of the Federal District fuel market with fuel markets of other state capital. We also describe the characteristics of the players involved in the cartel. The descriptive analysis provide insight on why the hub-and-spoke cartel took place in the Federal District and not in other markets.[15]

A. Market Overview

Table 1 displays summary statistics for variables that capture market size and the potential demand for fuel. The first column displays the statistics for the federal capital, the second to forth columns describe the distribution of the variables across state capitals. In comparison with state capitals, the Federal District is marked by a large potential demand for fuel. This is the case when we consider variables that affect the level of demand (e.g. population, car fleet per-capita and income), or variables that account for demand growth (e.g population growth and car fleet growth).

Table 2 displays summary statistics for variables describing the market structure in the Federal District and state capitals. For the state capitals we display the median in the main entry and the first and third quartile in parenthesis. We also show the statistics for three different time periods: (i) before the cartel was in

[14] These documents are available upon request.

[15] For historical reasons, most state capitals are also dense urban areas and thus provide a meaningful comparison group for the Federal District

Table 1—Cities' Summary Statistics

	Federal District	State capitals (n=18)		
		p10	median	p90
Population (millions)	2.75	0.53	1.17	3.93
Car fleet/Population	0.37	0.18	0.28	0.42
Population growth (%)	1.88	0.45	0.81	1.65
Car fleet growth (%)	5.54	3.34	4.91	6.49
Income (R$ 2015-01)	4,312.75	2,035.56	2,552.07	3,182.75
Urban area (km sq)	626.50	134.68	284.94	888.06

Note: Statistics refer to the years between 2007 and 2018

place (2007-2010); (ii) during the cartel (2011-2015); and (iii) after the cartel was dismantled (2016-2018).

Compared to state capitals, the Federal District has relatively few stations per vehicle and these stations face a small number of competitors in a 3km radius. Throughout our sample, most of the gas stations in the Federal District are branded. However, the share of unbranded stations in the Federal District has increased over time and reached a similar level to the median share of unbranded stations of other state capitals. Stations in the Federal District are also larger than stations in other state capitals in terms of tank size and number of pumps. Even so, the former submit more purchase orders per month to fuel distributors. The high number of purchase orders is plausibly related to the fact that potential demand for fuel is higher in the Federal District. Furthermore, the higher number of purchase orders also imply more frequent interactions between gas stations and the sales personnel from fuel distributors, which can be a factor that facilitates the hub-and-spoke collusion.

The relatively large potential demand for fuel in the Federal District in conjunction with the sparseness of the gas stations provide an explanation for the sizeable volume of gasoline sold per station. What it does not provide an explanation for is why the sales of ethanol per station in the Federal District falls substantially during the cartel period. We show in a subsequent section that this feature is associated with the modus operandi of the cartel.

On the upstream level, we have that the Federal District is more concentrated

on sales than other state capitals. This is evident when we look for the average number of fuel distributors selling to stations or when we consider the HHI measuring concentration in the sales of gasoline or ethanol. Different from state capitals, the concentration in the upstream level in the Federal District rises substantially during the cartel period and falls after the cartel is dismantled. As we argue in a subsequent section, this pattern is associated with how fuel distributors benefit from the gas station cartel.

Table 2—Fuel Markets' Summary Statistics

	2007-2010		2011-2015		2016-2018	
	State capitals	FD	State capitals	FD	State capitals	FD
Number of stations	155	264	170	302	179	311
	(110,261)		(118,277)		(121,275)	
Car Fleet/Number of stations	1750	3050	2007	3535	2270	3971
	(1233,2381)		(1545,2530)		(1767,2940)	
Fraction of unbranded stations	0.27	0.16	0.23	0.19	0.24	0.23
	(0.21,0.37)		(0.17,0.35)		(0.18,0.35)	
Tank Size (m^3)	32	43	31	41	31	41
	(29,34)		(28,33)		(28,34)	
Number of pumps	5	7	5	7	5	7
	(5,5)		(5,5)		(5,5)	
Avg number stations in 3km range	25.0	13.8	29.4	15.5	29.2	15.8
	(20.6,34.6)		(22.4,35.1)		(22.9,35.3)	
Approx number of orders in a month	3.7	5.9	4.9	7.4	5.0	7.8
	(2.9,4.3)		(4.3,6)		(4.1,5.8)	
Yearly Gas Sale/#Stations	132	300	173	364	181	382
	(104,170)		(155,196)		(144,223)	
Yearly Ethanol Sale/#Stations	48	66	32	27	32	27
	(38,76)		(18,50)		(22,63)	
Number of distributors*	13.0	9.2	12.3	8.6	12.4	9.2
	(9.2,15.9)		(9.2,14.6)		(9.4,14.6)	
HHI at distribution-Gas*	2350	3222	2450	3345	2256	2945
	(2037,2971)		(2156,3003)		(2069,2563)	
HHI at distribution-Ethanol*	2301	2571	2518	2995	2205	2822
	(1802,2842)		(2002,2757)		(1664,2470)	

Notes: The numbers displayed in parenthesis are the first and third quartiles. * Data starts in 2010.

B. Players

The retail market in the Federal District is characterized by one large player, Cascol, and a number of smaller station owners. The first column in table 3 describes the stations owned by Cascol. The second and third columns describe respectively the unbranded and the branded stations that are not owned by Cas-

col.

Cascol is a family-owned and long-established company that owns 90 stations (approximately 30% of all stations), 60 of them operate with an exclusive dealing contract (45 are with Petrobras and 15 are with Ipiranga) and 30 are unbranded. Cascol accounts for approximately 27% of the sales of gasoline in the Federal District. Cascol's high sales performance and small station size translate into a higher number of purchasing orders sent to distributors. The network size and the frequent interaction with distributors is one potential factor explaining its leadership role in the cartel, as we discuss more in appendix C. Excluding Cascol, the average station owner in the Federal District owns 3 stations.

Table 3—Gas Stations Summary Statistics

	Cascol	Branded	Unbranded
Number of stations	90	176	43
Gasoline sale share (%)	27.2	59.6	13.2
Gasoline sale (10^4 liter)	26.8	30.1	27.2
	(17.6)	(18.3)	(17.1)
Tank size (10^4 liter)	3.6	4.4	4.2
	(1.1)	(4)	(2.7)
Number of pumps	5.6	7.8	7.6
	(4)	(3.6)	(4.5)
Approx number of orders in month	7.8	7.4	6.7
	(4.9)	(3.5)	(3.2)
N stations in 1km range	3.9	4.1	4.1
	(3.7)	(3.7)	(3.3)

Notes: Notes: We compute statistics using a simple average for Jan/2015. Number in parenthesis is the respective standard deviation.

We draw four important points from the retail summary statistics: (i) the number of unbranded stations in the market is not significantly smaller than other markets, raising the possibility of fierce competition between distributors; (ii) there are significant asymmetries between stations, mainly due to geographic location, network size, stations capacity and vertical contract differences; (iii) Cascol is a natural candidate for being a leader in any retail price coordination; (iv) stations not owned by Cascol have enough aggregate capacity to contest

unilateral decisions from Cascol to raise prices.

At the distribution level, the Federal District is characterized by the dominance of the three large national players previously mentioned. Table 4 displays the market share of BR, Ipiranga and Raizen. While in most of the state capitals across the country BR, Ipiranga and Raizen have to compete with a significant number of smaller distributors, in the Federal District they account for 93% of the total sales of gasoline and 91% of the sales of ethanol in 2015. They also account for virtually all exclusive dealing contracts in the market. Between those three distributors, all have more than 20% of aggregate sales and all buy from the same Petrobra's supply point located inside the Federal District. Overall, their symmetry in size and cost, their multimarket contact and operational scale is indicative of larger incentives to cooperate with each other when compared with small and asymmetric stations.

Table 4—Top 3 Distributors Outcome Share - Jan 2015

	Gasoline Sale (%)	Ethanol Sale (%)	Exclusive Dealing contracts (%)
Ipiranga	27.3	28.5	21.9
BR	48.7	45.0	54.4
Raizen	17.6	17.9	23.2
Total FD	93.6	91.4	99.6
State capitals median	76.9	63.6	84.6

IV. The Performance of the Cartel

The communication between retailers and distributors captured by the police presents evidence that firms attempted to fix prices. But, it does not imply that firms succeeded to do so. Next, we uncover the impact of the cartel on the retail price dispersion and on markups between 2011 and 2015. We show that firms were able to coordinate on an uniform price and charge an overprice throughout the period.

Figure 2 displays weekly retail and wholesale price dispersion for gasoline from

2011 to 2020. As the figure points out, the cartel was successful in eliminating dispersion in retail prices across the Federal District. Throughout the entire period that the police investigation documented explicit communication between stations, we have the standard deviation of retail prices below 2¢. The small retail price dispersion lasts until March of 2016, which is when the regulator started the intervention in the fuel retail market. Notice that the weekly wholesale price standard deviation is also small. However, for most of the period prior to the cartel break the dispersion of wholesale prices is higher than the dispersion in retail prices. As a consequence, the retail pricing patterns do not seem to be explained by the lack of cost heterogeneity across stations.

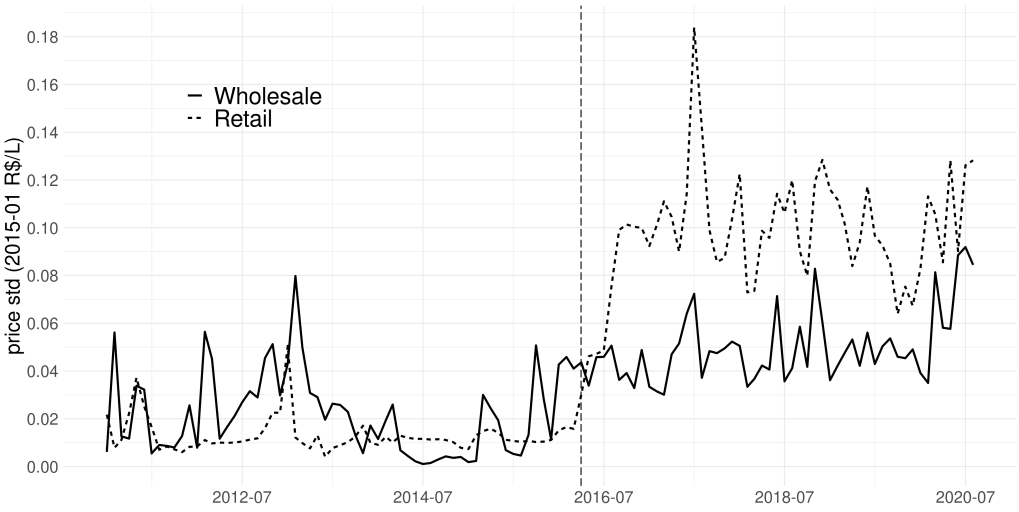


Figure 2. Week Retail and Wholesale price dispersion - Month Average

Clark and Houde (2013) also observe a gasoline cartel where members coordinate in a small number of retail prices. We envision three main causes linked to the choice of a retail cartel for an uniform price strategy. The inability to control where consumers buy the product, the coordination costs involved in any more sophisticated price strategy specially when a large number of members are involved, and the benefits that a uniform price brings to monitoring compliance.

However, the uniform price strategy under asymmetric members can create additional constraints on the maximal price level the cartel is able to coordinate on. In the absence of a feasible horizontal transfer mechanism it can create a role for a hub-and-spoke scheme, as we discuss in section VI.

To compute a measure of overprice, the competition authority used the retail and wholesale price margins observed after Cascol's intervention as a counterfactual measure of the margins that would have been in place during the years of 2011 to 2015. This exercise has many caveats, chief among them is the fact that macroeconomic conditions have changed considerably during the period of analysis. We propose a different way to compute the counterfactual prices for the cartel's years. We build upon Abadie and Gardeazabal (2003) and construct a synthetic control for the Federal District's fuel market. The fuel markets from state capitals across the country are the potential control units. We choose the weights attributed to each state capital in the analysis by minimizing the distance between a vector of characteristic from the treatment and from the control units. The characteristics used reflect aspects of the demand for fuel and also information on gasoline price margins for years after the cartel broke. We present more details on the synthetic control exercise, such as the exact weights and the treatment-control balance table, in appendix B.

Figure 3 indicates that the cartel succeeded in generating above normal profits from gasoline sales. We define markups as the difference between the selling price and the buying price, divided by the selling price, and we calculate it for the retail, the wholesale, and for the whole supply chain.[16] During the cartel years the average markup in the Federal District's gasoline supply chain kept increasing and was on average 4.9 percentage points above the markup on the synthetic control. In particular, retailers were able to sustain markups 2.2 percentage points above control and distributors 3.2 p.p., on average.[17] Considering that average markup

[16]The markup for the supply chain is the retailer's selling price minus the wholesaler's buying price, divided by the former.

[17]Retail markups were higher than the average of other capitals even before 2011. It is possible that

in the synthetic control is 16% and that aggregate quantity follows a positive trend through all the period, we can conclude that the cartel had an economic significant impact on profits.[18]

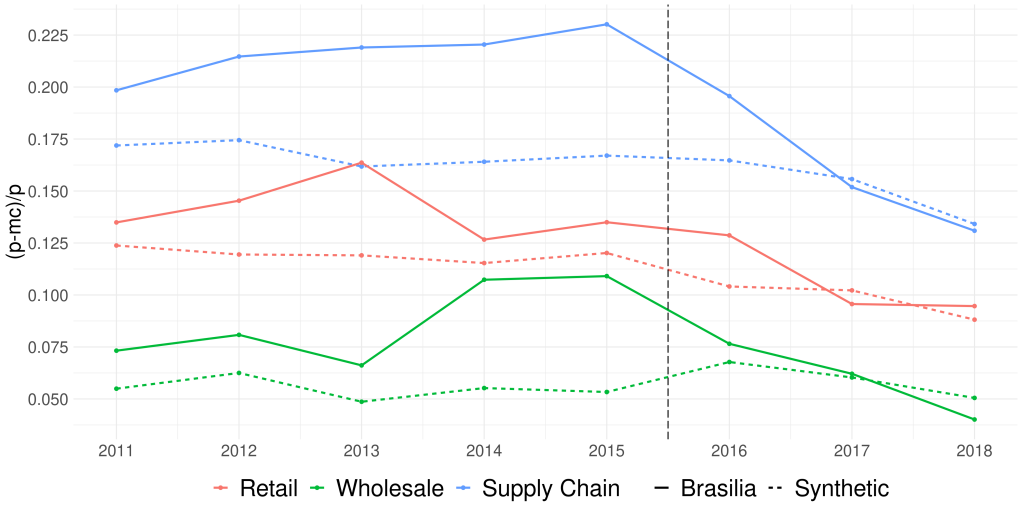


FIGURE 3. MARK-UP EVOLUTION

The ability to set uniform prices, the overprice charged by the cartel and the duration of the agreement show that stations solved the coordination and enforcement problems and were able to collude. Despite higher retail prices, and incentives to avoid double marginalization, the estimates also show that distributors benefited from the collusive agreement. Next, we rely on patterns in the data to argue about a possible mechanism that allowed the upstream firms benefit from the hub-and-spoke scheme. In section VI we focus on the vertical strategies used by the distributors to help the cartel succeed. We defer to appendix C for a detailed analysis of the horizontal strategies used by retailers.

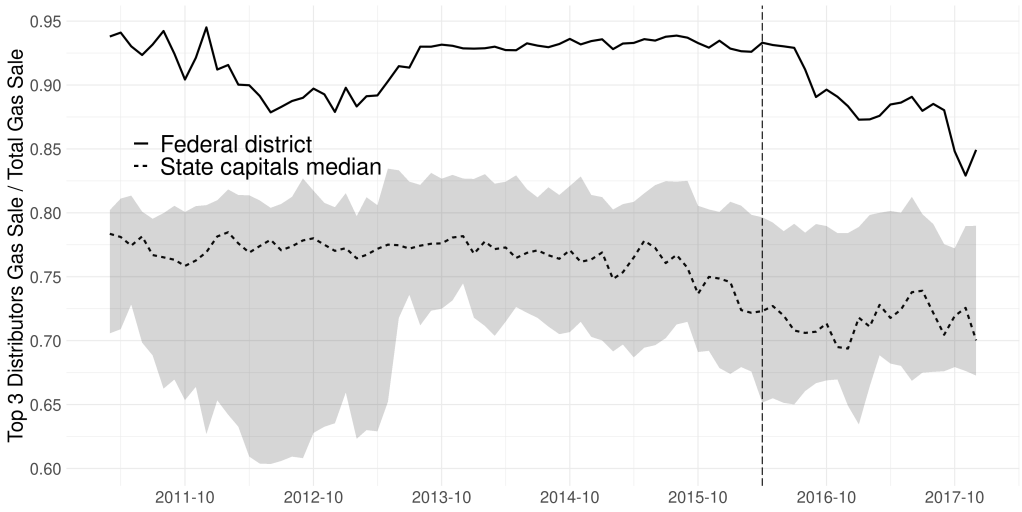
some price coordination existed before 2011, but the police investigation only supports the existence of a fully operational cartel starting in 2011.

[18]To check the robustness of our estimates we run placebo tests using each state capital as pseudo treated unity. In table D3 on appendix D we can not find an excessive markup larger than the one found for the Federal District.

V. How does the hub benefit from the cartel?

In February of 2016, with the objective of terminating the illicit behavior, the Brazilian antitrust authority determined a legal intervention in the market. As such, Cascol's management board was replaced by a government appointee. The appointee's task was to cease any illegal activity in the company while maintaining it fully operational.

Even though the competition regulator did not directly intervene in the upstream level of the supply chain, we do see a significant change in the distributor's market share after the cartel broke.[19] From figure 4 we observe that the gasoline sales share of the top 3 distributors in the Federal District kept steady between 90% to 95% during all the 2010-2015 period. But, right after the intervention in January of 2016, this share plunges to as low as 80%. We do not see the same movement in the average share for the same distributors in other markets.



Notes: Shaded area refer to the first and third quartile of the state capital's distribution.

FIGURE 4. TOP 3 DISTRIBUTORS' SALES SHARE

[19] Judicial fines and arrests of distributor's sales representatives were determined only in August of 2018.

Using the data on quantity sold by distributors, we find that most of the reduction in gasoline sales share of the top 3 distributors is caused by an increase in sales of small incumbent distributors, and not by the entry of new gas stations or upstream players. Since the small distributors did not have exclusive dealing contracts with gas stations, almost the totality of the increase in sales is due to unbranded stations choosing to buy from the smaller distributors after the cartel broke. The change in behavior from the unbranded stations is puzzling when we consider that both large and small distributors buy gasoline from the same state-owned company and thus have marginal costs that evolve in a similar fashion. Moreover, we observe the same small distributors charging lower prices in nearby markets outside the Federal District during the cartel periods, which refutes the possibility of significant differences in cost.[20]

The reduction in market-share from the top 3 distributors after the end of the cartel raises the question of whether the upstream concentration was part of a coordinated equilibrium between retailers and the large distributors. Downstream players could be trading upstream exclusion for assistance with their collusive project. Although less recognized in the antitrust literature, this possibility can explain why in a large number of cartel cases we observe sophisticated buyers or sellers not actively working to dismantle cartel activities in another level of the supply chain.

We are not the first to raise the possibility of a exclusionary-collusive agreement between firms in different levels of the supply chain. Another example is presented in Asker and Hemphill (2020) for the American sugar industry at the end of the nineteen century. In their case, wholesalers from New York and New England approached a trust of sugar refineries with the proposal for the trust to help wholesalers to raise prices by building a minimum resale price maintenance scheme. The trust agreed to help the wholesalers if as a counterpart the

[20] During 2015, we observe the same small distributors charging prices up to 5% lower than the average wholesale price in the FD in close markets, such as GO-Goiania.

wholesalers conferred exclusivity in sales for the trust. The agreement effectively excluded possible upstream rivals, such as import companies and domestic entrants.

Asker and Bar-Isaac (2014) rationalize this exclusionary coalition behavior even in the absence of formal contracts. The authors show that different vertical practices from a dominant incumbent wholesaler can work as transfers to downstream retailers. In equilibrium, retailers internalize the profits coming from the wholesaler dominant position and help sustain that position by not buying from other wholesalers. Although Asker and Bar-Isaac (2014) refer to explicit vertical practices such as resale price maintenance, indirect actions from the distributors that help sustain a coordinated price between retailers can have similar effects.

An exclusionary equilibrium with collusive downstream agents would only work if vertical practices from the upstream agent are key to the stability of the downstream coordination. Next, we present evidence on three vertical practices from the distributors that could have helped sustain the retail price coordination.[21]

VI. How does the hub help the cartel?

Current work on hub-and-spoke collusion points to information sharing as the main action taken by the hub to support collusion by the spokes (Sahuguet and Walckiers, 2017; Harrington Jr, 2018). We argue that the hub can take a more active role in the collusive agreement. Specifically, we show that distributors pricing behavior is consistent with the implementation of vertical transfers to retailers. The transfers took both an explicit form through wholesale price discounts during episodes of price wars, and an implicit form through geographical wholesale price discrimination. We also present evidence that distributors used the wholesale price to smooth cost fluctuations and reduce the cartel's need of coordinating price changes.

[21] In a companion paper, Chaves and Duarte (2021), we quantify the importance of one of the distributors' actions for the incentive constraints faced by the downstream cartel during that period.

A. *Price Wars' Subsidies*

The conversations wiretapped by the police and the plea bargain signed by Cascol are clear when explaining how firms dealt with deviations from the agreed price. The cartel members proceeded in two steps. First they reached the station that deviated and tried to persuade it to come back to the agreement. If the conversations were not successful, then the members of the cartel started a punishing phase. Punishments were implemented by lowering the prices of stations located in the vicinity of the station that broke the agreement. Although it is not clear how frequent the occurrence of price wars was, the documents mention two occasions during the year of 2015.[22]

Conversations between stations and distributors during the punishment phase are also documented by the police investigation. In the conversations, distributors offered wholesale price discounts to the gas stations involved in the price wars. The discounts were extended to everyone, except for the station that triggered the war. The discounts were of at most 10 cents per liter and were made to be fully passed to the retail price.[23] Furthermore, the discounts stopped as soon as the prices came back to "normal".[24]

The wholesale price discount given by distributors during the episodes of price wars provides a clear benefit to the stations. With the discount, stations are able to reduce retail prices while keeping markups unchanged. Hence, punishments are more credible and stations have less incentives to deviate from the agreement.[25]

[22] In one of the reported price wars, the wiretaps captured the motivations of the station that started the war, quote 11

[23] In quote 2 on appendix E Cascol's general manager described how the price war subsidies worked.

[24] Since the price data comes from a survey of around 10% of the gas station population, it is hard to precisely capture a price war between stations.

[25] In the Canadian sugar cartel described by Asker and Hemphill (2020) punishing defections were also made easier with the help from the hub.

B. *Geographical wholesale price discrimination*

As the descriptive analysis indicates, the local market environment faced by stations varies significantly across the Federal District. It depends on demand conditions (closer to a high-traffic commute path, rich neighborhood) and on the number of close competitors (zoning laws, first-mover advantage).[26] The differences in geographical characteristics between stations can imply significant differences in the incentives firms have to deviate from the collusive price. While isolated stations have a captive demand and therefore would not gain much by deviating from the coordinated price, stations that are close to others can steal a large number of customers with a small reduction in prices.

Although the uniform price strategy can be a response to other coordination challenges, the single price level chosen would be constrained by the less differentiated stations, since they would deviate at a much lower price level compared to the more differentiated stations. In other words, if the wholesale prices are the same and the cartel must choose an uniform price, then the incentive compatible price level chosen is driven by the incentive constraint of the less geographically differentiated stations. Similar to other asymmetric conditions like differences in cost or network size, the enforcement and agreement problems that horizontal differentiation creates could be solved with some form of transfer between members.

At the same time, we observe a change in the correlation between wholesale prices and station location after the cartel broke. Using a variance decomposition approach similar to Card, Heining and Kline (2013), we decompose the variance of the wholesale price into geographical, cost, and station-size components. In table 5 we compare the importance of each component while discriminating the periods during and after the cartel. Compared to the years after intervention, during the cartel geographical location had a bigger contribution than vertical

[26] In appendix A figure A2 we plot the location map of stations across the FD.

contracts to the differences in wholesale prices.

Table 5—Wholesale Price Variance Decomposition

2011-2015

	Unbranded	Cascol	Tank	Pump	Gas Cost	AR_FE
Unbranded	0.30					
Cascol	0	0.87				
Tank	0	-0.01	0.01			
Pump	-0.08	-0.31	0.02	0.80		
Gas Cost	0.31	1.40	-0.08	-0.88	43.18	
AR_FE	-0.08	0.11	0	-0.17	-1.07	7.98

2016-2018

	Unbranded	Cascol	Tank	Pump	Gas Cost	AR_FE
Unbranded	0.38					
Cascol	0	0.03				
Tank	0	0	0			
Pump	-0.01	0	0	0.10		
Gas Cost	0.15	0.09	0	0.39	88.45	
AR_FE	0.10	0	0	0.01	0.60	0.39

Notes: $1 = [Var(AR_s) + Var(x_s\beta) + Var(c_t\gamma) + 2Cov(AR_s, x_s\beta) + 2Cov(AR_s, c_t\gamma) + 2Cov(x_s\beta, c_t\gamma) + Var(\varepsilon_{s,t})] / Var(w_{s,t})$ where AR stands for administrative region, x are other characteristics, c is the refinery cost and w the wholesale price. Values are in percentage terms. Off diagonal elements refer to the covariance term.

Although horizontal transfers are also an option, the wholesale price can work as a tool to curb incentives to deviate from coordination. For example, Piccolo and Miklós-Thal (2012) discuss the role that wholesale prices and slotting fees can have for cartel stability in a symmetric agents environment with negotiated vertical contracts. The authors show that, if retailers have buying power, then they could trade higher slotting fees for higher wholesale prices, which under some conditions would decrease the critical time discount factor necessary to sustain collusion. A similar approach could work in an asymmetric environment, if larger wholesale prices are paid by less differentiated firms. In Chaves and Duarte (2021), we formalize this intuition in a model of hub-and-spoke collusion with horizontally differentiated firms, and we provide evidence that less differentiated stations were paying higher wholesale prices during the Federal District gasoline cartel.[27] We also estimate a structural model of demand and the incen-

[27]More interesting, we show that this difference disappear after the cartel broke. These results are robust to the measures of geographical differentiation and to the inclusion of a rich set of controls.

tive compatibility constraints of the cartel members to quantify the impact of the wholesale price discrimination strategy on the stability of the cartel.

C. *Cost Smoothing*

A distinct feature of the Brazilian fuel industry is the significant share of bifuel automobiles, i.e, vehicles that run on gasoline, ethanol or any combination of both. These vehicles account for half of the vehicle fleet in the Federal District.[28] As a consequence, every gas station offers the two fuel alternatives and the same distributors provide both ethanol and gasoline. Because ethanol has a lower energy content when compared to gasoline, the consumption of the former is advantageous for the average consumer only if the price ratio between ethanol and gasoline falls below 75%.

The investigation documents indicate that distributors were actively setting the ethanol wholesale prices in a level that discouraged the consumption of ethanol. While it is not clear from the documents how this behavior would have helped the cartel, the investigation presents strong evidence that it indeed was happening. For example, one wiretapped phone call between Cascol managers and distributors' sales representatives shows Cascol helping distributors to share information on ethanol wholesale price levels and directing one of them to set higher prices.[29]

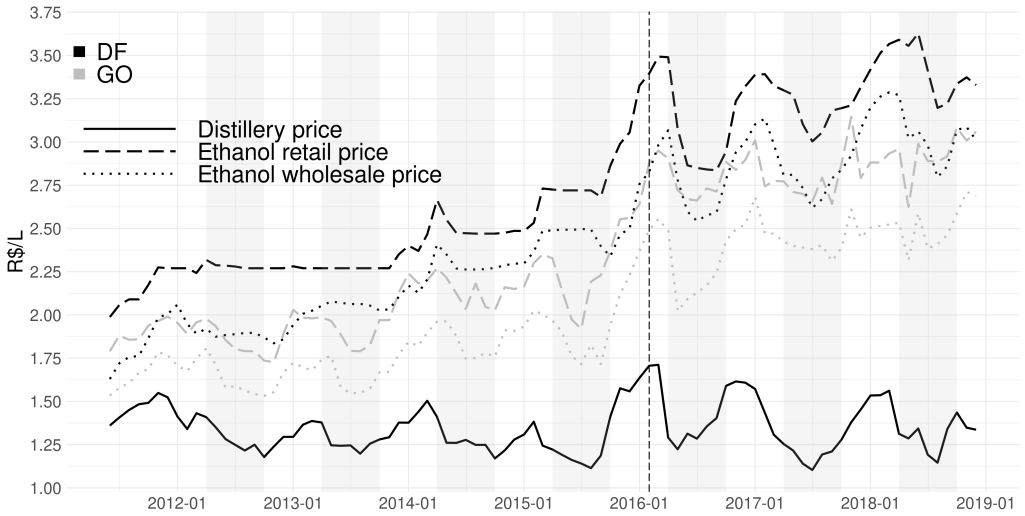
To investigate if distributors were setting prices to discourage the consumption of ethanol, we focus on all the prices across the Federal District's ethanol supply chain and compare them with the retail and wholesale prices in a nearby market where we do not have evidence of a cartel.[30]. Figure 5 displays the evolution of the ethanol distillery, wholesale and retail price. The shaded bars highlight sugarcane harvest periods, from May to September. After the alleged time frame of the cartel, wholesale prices in both markets had similar responses to reductions in

[28] In January 2015, 47.3% of the vehicles registered in Brasilia were bifuel. We believe the figure is even higher if we consider only cars used for commute.

[29] Quote 7. For another example, we refer to quote 8.

[30] GO-Goiania is the closest state capital from Brasilia, where the top 3 national players are also present and with similar fuel tax levels.

the distillery price. In contrast, during the time the cartel was fully operational reductions in the distillery price where not followed by reductions on the ethanol wholesale price in the Federal District. There was no entry or exit of major players in the distribution level between periods. In addition, during the cartel time window ethanol retail prices in the Federal District always stayed above the threshold of 75% of the gasoline price, while in other markets and during years outside the cartel time window we do observe periods of ethanol retail price below the 75% threshold. This behavior had negative consequences for the total quantity of ethanol consumed in the Federal District. [31]



Notes:: Note: Dashed vertical line refer to the cartel period. Shaded vertical bars refer to sugar-cane harvest periods

FIGURE 5. ETHANOL COST PASS-THROUGH

To go beyond the anecdotal evidence, we extend the comparison of the ethanol prices in the Federal District to all other state capitals. We regress the week average ethanol wholesale price on the ethanol distillery price from one week before while allowing for different pass-through coefficient for the cartel period,

[31] In appendix A figure A1 presents the comparison of the ethanol retail price and the 75% threshold of gasoline retail price, and table 2 the consumption per station of gasoline and ethanol in the FD and state capitals.

for the Federal District, and for their interaction.[32] Table 6 displays the result of this regression. As the estimates indicate, on average, half of a distillery price shock passes through ethanol wholesale prices. Outside of the cartel period, the average pass-through in the Federal District is not statistically different than the average pass-through in other state capitals. However, the average pass-through decreases significantly for the Federal District during the cartel period. This decrease is not observed in the other state capitals. A Wald test for the sum of the coefficients fails to reject the hypothesis that during the cartel period, the average pass-through of distillery prices on the ethanol wholesale price in the Federal District is equal to zero.

Table 6—Ethanol Wholesale Price Pass-through

	Ethanol Wholesale Price
Distillery Price	0.510
	(0.020)
Distillery Price× FD	−0.053
	(0.077)
Distillery Price×Cartel period	−0.073
	(0.008)
Distillery Price×FD×Cartel period	−0.568
	(0.161)
Observations	6,043
Adjusted R^2	0.632

Notes: FD is a dummy for the Federal District market. Cartel period is a dummy for time between the years of 2012 and 2015. We control for market fixed-effects, demand characteristics (car fleet/population, percentage of bifuel vehicles), ethanol taxes (ICMS, PIS/COFINS) and a dummy for FD×Cartel period. Standard errors are calculated using a Newey-West correction for autocorrelation within market with a maximum lag order of 4.

The reason why reducing the consumption of ethanol is beneficial for the cartel becomes evident when we consider the difference in cost volatility between gasoline and ethanol. Figure 6 displays the evolution of ethanol distillery price and the gasoline refinery price. Compared to gasoline, the cost of ethanol for distributors is highly volatile. From early 2000s until the end of 2016 the Brazilian government adopted an economic policy that used the monopoly position from Petrobras in

[32] We refer to Miller, Osborne and Sheu (2017) as how to compute market-wide cost pass-through in imperfectly competitive markets.

the refinement level as a tool to smooth the impact of international oil price shocks into the gasoline price. This policy translated into stable costs for the gasoline supply chain. In contrast, the price of ethanol is more volatile not only due to the natural seasonality from the harvest period between May and August, but also due to the predominance of small producers in the production level.

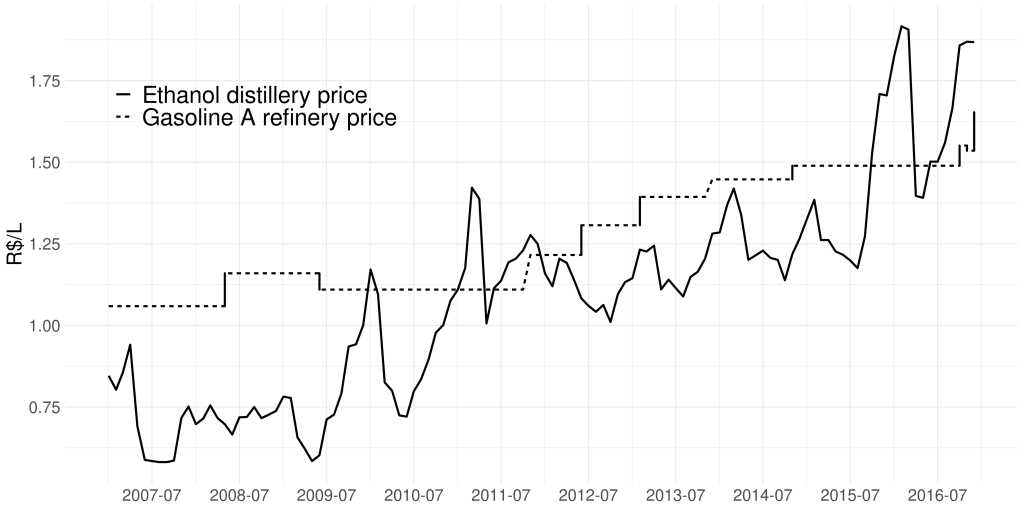


Figure 6. Ethanol vs Gasoline Cost Volatility

Because ethanol constitute 20% of the gasoline sold to consumers and because of the substitutability between ethanol and gasoline as fuel alternatives, we observe the seasonality on costs from the ethanol being transmitted onto the retail prices of gasoline for most fuel markets in Brazil.[33] However, as can be seen in figure 7, when we compare the gasoline retail price from the Federal District with the retail price from the same nearby market used for figure 5, the seasonality from ethanol harvest months in the former is not evident.[34] Based on the literature, we envision three arguments on why selling less ethanol and facing stable gasoline

[33]In appendix A table A2 we capture the seasonality of the retail gasoline price during ethanol harvest months using our data.

[34]We formalize this evidence by computing the pass-through of ethanol distillery prices on the gasoline retail price for the Federal District and the state capitals in table A3 of appendix A

costs could have helped the stability of the retail cartel in the Federal District.[35,36]

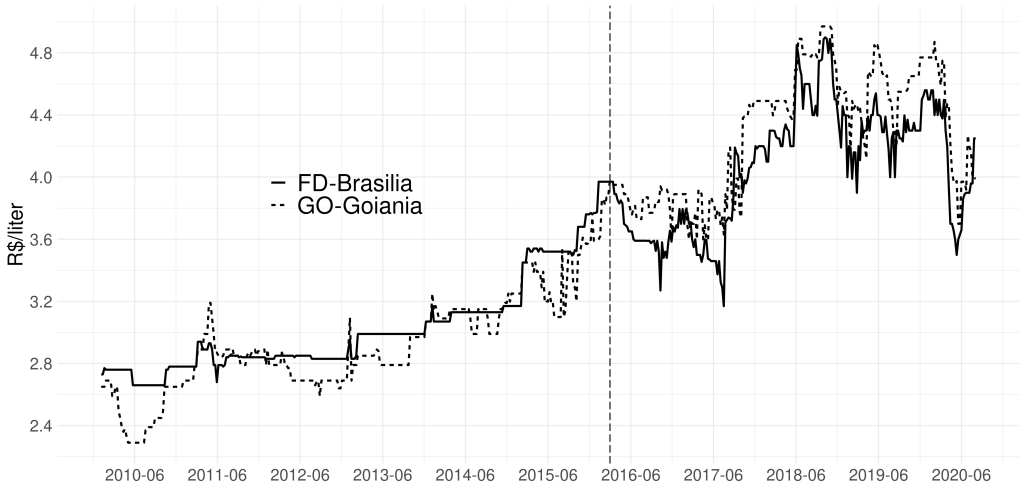


Figure 7. Gasoline Retail Price Seasonality

First, cartels have incentives to avoid frequent changes in the coordinated price. Clark and Houde (2013) present evidence on the necessity of cartels to increase communication during periods of price change coordination. At the same time, a large number of cartel litigations is sustained on evidence collected from communications between members during price or quota adjustments.[37]. If the expected cost of litigation enters into the gas station's expected profits, then the envision of frequent price changes and the necessity of intense communication between members can stop the stations from entering into the cartel in the first place.

Second, past papers have shown the importance of clear focal points for the stability of cartels (Knittel and Stango, 2003; Lewis, 2015). Specifically for the

[35]The police report also state that the price of ethanol is bad for the cartel because of the price changes during the year, quote 9.

[36]Lemus and Luco (2020) show an inverse channel for the Chilean gasoline retail market , where less uncertainty about future wholesale prices decreased the incentives to build tacit collusion. They explain it using the fact that the monopolist profit is convex in the marginal cost. Although it is possible that this channel exist in our case, the evidence shows that inside Brazil's institutional environment the losses involved in a high volatile cost scenario surpass the gains from a convex profit function for the cartel.

[37]Most of the retail price changes we see in figure 7 is due to large and punctual changes in tax or in Petrobras' prices.

fuel industry, Byrne and De Roos (2019) show how focal points can be created by the repeated interaction between gas stations. They also present evidence that unexpected cost shocks, such as large variations in the international oil price, can undo the collusive behavior and create the need to reestablish the focal point. However, the process of reestablishing the focal point is costly, specially for the leader member. Therefore, if the process of establishing a new focal point is significantly costly and players face a large volatility in future costs, then the cartel may not be sustainable in the first place.

Third, we consider that different retailers have different capacities and potentially purchase fuel in different days. Large variability in ethanol costs may exacerbate the asymmetries in cost between retailers and allow frequent buyers to have more opportunities to deviate. As discussed before, asymmetries can create the need of transfers between members. Therefore, if we consider that frequent cost changes can create significant asymmetries in cost and the need of more sophisticated transfers between members, then distributors can help stabilizing the cartel by shifting sales to the product with lowest volatility in cost.[38]

VII. Conclusion

The implementation of a successful collusive agreement requires firms to overcome a variety of obstacles. First, firms need to agree and coordinate on an incentive compatible price. This coordination problem is exacerbated in settings with asymmetric firms that have preferences for different collusive prices. Second, as the cartel raises prices, it gives firms an incentive to cheat. This requires firms to monitor the competition and punish those that deviate from the agreement. Third, the cartel must be able to deal with cost fluctuations, which may require frequent price changes and thus increase the likelihood of detection.

We use the documents produced by a police investigation and detailed data on

[38] Clark and Houde (2013) is an example of the challenges faced by stations when implementing transfers during coordinated price changes.

the supply chain to study a hub-and-spoke cartel in the automotive fuel market in Brazil's Federal District. We quantify the rents obtained by the cartel and characterize the strategies used by firms to solve the obstacles to collusion.

We show that fuel distributors (hub) helped to solve the coordination and enforcement problems faced by gas stations (spokes). We depart from current work on hub-and-spoke cartels (Sahuguet and Walckiers, 2017; Harrington Jr, 2018; Clark, Horstmann and Houde, 2020) by showing that the role of the hub in the cartel is not restricted to being an information transmitter between spokes. As indicated in the documents and consistent with wholesale pricing patterns, the hub acted to implement transfers, reduce asymmetries, and reduce the frequency of price changes between the spokes. To this end, the hub relied on wholesale price discounts during episodes of price wars, wholesale price differentiation based on the location of each station, and smoothing cost shocks faced by stations. Our analysis suggests that firms behavior is consistent with gas stations trading upstream exclusion for assistance with their collusive project. This type of exclusionary agreement is of interest to academics and antitrust authorities. It depicts a vertical arrangement that hasn't been completely understood and it provides a potential explanation of why sophisticated buyers or sellers do not actively work to dismantle cartel activities in another level of the supply chain.

Our case is also illustrative on how hub-and-spoke schemes can interchange coordination costs between levels of the supply chain and leverage on differences in market structure. We can make a strong argument that the upstream hub formed by the three large national distributors had a slacker incentive constraint, compared to the small, asymmetric and crowded downstream level. The actions from the hub could have shifted part of the costs involved in the downstream coordination to a level of the supply chain that was better able to absorb it without triggering deviations. Since this difference in market structure between levels is also observed in other hub-and-spoke situations (Harrington Jr, 2018), the overall evidence strongly support for it being a necessary condition for a

hub-and-spoke scheme.

Finally, the case analysed opens up questions on how antitrust authorities can define the culpability for each part of the hub-and-spoke agreement and the penalties each should face. In our case, managers were arrested, and fines were imputed to distribution companies. However, the bulk of penalties were directed to the gas station owners. In contrast to information sharing, which empirical assessment of its relevance can be challenging, we presented hub-and-spoke mechanisms that are more accessible to quantification through a structural model of pricing and incentive constraints. If it can be shown that with the absence of at least one of those channels the cartel could not have survived, then a legal argument on the imputation of fines could lean heavily on the hub.

References

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2011. "Synth: An R package for synthetic control methods in comparative case studies." *Journal of Statistical Software*, 42(13): 1–17.

Abadie, Alberto, and Javier Gardeazabal. 2003. "The economic costs of conflict: A case study of the Basque country." *American Economic Review*, 93(1): 113–132.

Asker, John. 2010. "A study of the internal organization of a bidding cartel." *American Economic Review*, 100(3): 724–762.

Asker, John, and C. Scott Hemphill. 2020. "A Study of Exclusionary Coalitions: The Canadian Sugar Coalition, 1888-1889." *Antitrust Law Journal*, 83(1): 1887–1889.

Asker, John, and Heski Bar-Isaac. 2014. "Raising retailers' profits: On vertical practices and the exclusion of rivals." *American Economic Review*, 104(2): 672–686.

Byrne, David P., and Nicolas De Roos. 2019. "Learning to coordinate: A study in retail gasoline." *American Economic Review*, 109(2): 591–619.

Card, David, Jörg Heining, and Patrick Kline. 2013. "Workplace Heterogeneity and the Rise of West German Wage Inequality." *The Quarterly Journal of Economics*, 128(3): 967–1015.

Chaves, Daniel, and Marco Duarte. 2021. "Hub-and-Spoke Collusion and Horizontal Differentiation: Theory and Evidence from the Automotive Fuel Industry."

Clark, Robert, and Jean François Houde. 2013. "Collusion with asymmetric retailers: Evidence from a gasoline price-fixing case." *American Economic Journal: Microeconomics*, 5(3): 97–123.

Clark, Robert, and Jean François Houde. 2014. "The effect of explicit communication on pricing: Evidence from the collapse of a gasoline cartel." *Journal of Industrial Economics*, 62(2): 191–228.

Clark, Robert, Ig Horstmann, and Jean-François Houde. 2020. "Two-sided hub-and-spoke collusion : Evidence from the grocery supply chain."

Genesove, David, and Wallace P. Mullin. 2001. "Rules, communication, and collusion: Narrative evidence from the sugar institute case." *American Economic Review*, 91(3): 379–398.

Harrington Jr, Joseph E. 2018. "How Do Hub-and-Spoke Cartels Operate? Lessons from Nine Case Studies."

Igami, Mitsuru, and Takuo Sugaya. 2021. "Measuring the incentive to collude: The vitamin cartels, 1990-1999." *Available at SSRN 2889837*.

Jacquemin, Alexis, and Margaret E Slade. 1989. "Cartels, collusion, and horizontal merger." In *Handbook of industrial organization*. Vol. 1, Chapter 7, 415—-473. Elsevier.

Knittel, Christopher R., and Victor Stango. 2003. "Price ceilings as focal points for tacit collusion: Evidence from credit cards." *American Economic Review*, 93(5): 1703–1729.

Lemus, Jorge, and Fernando Luco. 2020. "Price Leadership and Uncertainty about Future Costs."

Levenstein, Margaret C., and Valerie Y. Suslow. 2012. "Cartels and Collusion - Empirical Evidence." *SSRN Electronic Journal*, 2(December 2019): 1–26.

Lewis, Matthew S. 2015. "Odd Prices at Retail Gasoline Stations: Focal Point Pricing and Tacit Collusion." *Journal of Economics and Management Strategy*, 24(3): 664–685.

Magnolfi, Lorenzo, and Camilla Roncoroni. 2016. "Political Connections and Market Structure." *Working Paper*.

Miller, Nathan H., Matthew Osborne, and Gloria Sheu. 2017. "Pass-through in a concentrated industry: empirical evidence and regulatory implications." *RAND Journal of Economics*, 48(1): 69–93.

Piccolo, Salvatore, and Jeanine Miklós-Thal. 2012. "Colluding through suppliers." *RAND Journal of Economics*, 43(3): 492–513.

Röller, Lars Hendrik, and Frode Steen. 2006. "On the workings of a cartel: Evidence from the Norwegian cement industry." *American Economic Review*, 96(1): 321–338.

Sahuguet, Nicolas, and Alexis Walckiers. 2017. "A theory of hub-and-spoke collusion." *International Journal of Industrial Organization*, 53: 353–370.

Van Cayseele, Patrick, and Simon Miegielsen. 2013. "Hub and spoke collusion by embargo."

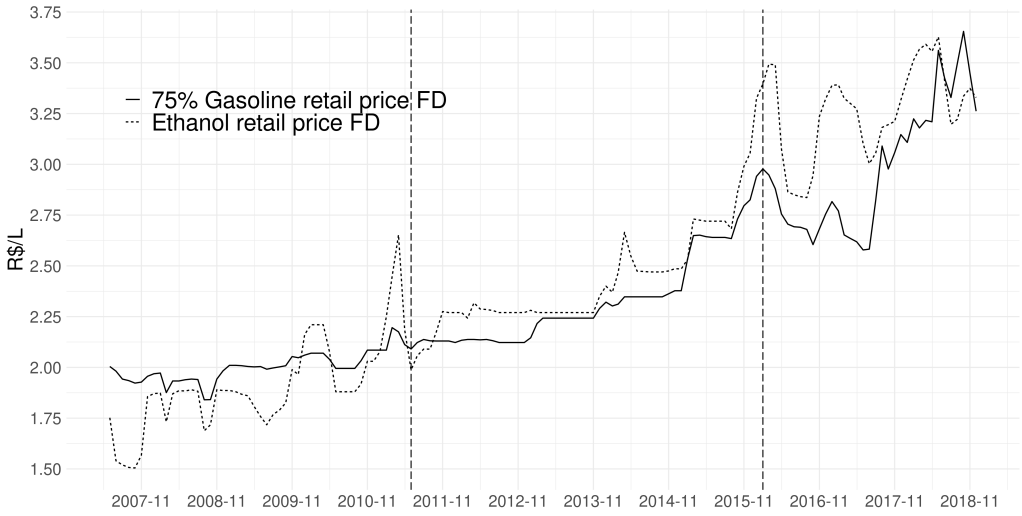
Tables and Graphs

Table A1—Fuel Markets' Prices and Markups

	2007-2010		2011-2015		2016-2018	
	State capitals	FD	State capitals	FD	State capitals	FD
Retail Gas Price	3.65	3.73	3.18	3.33	3.3	3.4
	(3.58,3.72)		(3.12,3.21)		(3.24,3.4)	
Wholesale Gas Price	3.19	3.23	2.76	2.83	2.93	3.05
	(3.11,3.24)		(2.71,2.81)		(2.9,3)	
Retail Ethanol Price	2.47	2.64	2.53	2.57	2.68	2.78
	(2.33,2.56)		(2.32,2.67)		(2.42,2.82)	
Wholesale Ethanol Price	2.10	2.09	2.22	2.28	2.31	2.45
	(2.03,2.2)		(2.03,2.34)		(2.17,2.47)	
Retail Gas Markup	0.13	0.16	0.13	0.14	0.11	0.10
	(0.12,0.15)		(0.11,0.14)		(0.09,0.12)	
Retail Ethanol Markup	0.14	0.20	0.12	0.12	0.12	0.11
	(0.13,0.15)		(0.11,0.13)		(0.1,0.13)	
Wholesale Gas Markup	0.04	0.06	0.05	0.08	0.05	0.05
	(0.04,0.06)		(0.04,0.06)		(0.04,0.06)	
Wholesale Ethanol Markup∗	0.01	-0.01	0.07	0.08	0.08	0.07
	(-0.01,0.04)		(0.04,0.09)		(0.05,0.11)	

Notes:

Figure A1. Ethanol retail price vs 75% Gas retail price



Note: The 75% threshold should be understood as a rule-of-thumb for the fuel decision. The reference threshold can vary depending on engine performance, although it does not vary by much.

FIGURE A2. STATIONS LOCATION AND VERTICAL CONTRACTS - FEDERAL DISTRICT

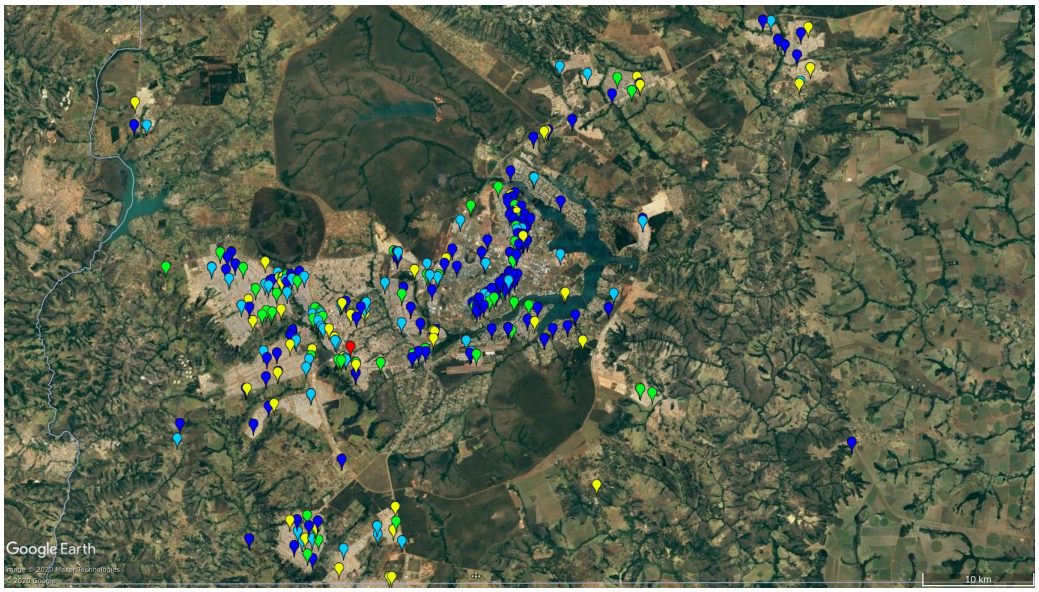


TABLE A2—GASOLINE RETAIL PRICE SEASONALITY

Jan		Feb	Mar	Apr	May	Jun	Jul
3.308	+	0.003	-0.002	-0.028	-0.051	-0.076	-0.073
(0.008)		(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)

Jan		Aug	Sep	Oct	Nov	Dec
3.308	+	-0.06	-0.057	-0.028	-0.019	-0.016
(0.008)		(0.011)	(0.011)	(0.011)	(0.011)	(0.011)

Notes: Coefficients from a regression of the gasoline week average retail price (R$2015-01 values) on dummies for months of the year, for observations during the period 2010-2019 in the FD and state capitals. The constant coefficient represents the average price in January. Months with negative and significant coefficients match with the ethanol harvest season months.

DATA

From ANP we obtained data on prices, stations characteristics and volume of fuel purchased by gas stations. Since July 2001, ANP runs a weekly survey covering 455 Brazilian municipalities that are representative of the country. In each municipality, ANP collects detailed price information from a random sample

Table A3—Gasoline Retail Price Pass-through

	Retail Gas Price
Gas price on refinery	0.510
	(0.020)
Gas price on refinery× FD	−0.053
	(0.075)
Gas price on refinery×Cartel period	−0.073
	(0.008)
Gas price on refinery×FD×Cartel period	−0.568
	(0.158)
Observations	6,043
Adjusted R^2	0.632

Notes: FD is a dummy for the Federal District market. Cartel period is a dummy for time between the years of 2012 and 2015. We control for market fixed-effects, demand characteristics (car fleet/population, percentage of bifuel vehicles), ethanol taxes (ICMS, PIS/COFINS) and a dummy for FD×Cartel period. Standard errors are calculated using a Newey-West correction for autocorrelation within market with a maximum lag order of 4.

of stations while taking into account geographic coverage.[39] The information collected includes the retail and wholesale prices of gasoline and ethanol, the name of the distributor that sold the respective fuel to the station, the brand affiliation (if any) and the address of the station.

The retail price information refers to the price observed by the interviewer during the survey, while the wholesale price refers to the unit price payed by the station for the last buying order sent to a distributor. The data on stations characteristics covers every station in the country. It includes measures of station capacity, like the size of the fuel tanks and the number of nozzles, and exclusive dealing contracts. For the distribution level, we obtained the list of distributors that operate in each state of the country as well as the monthly volume sold by each distributor in a given municipality. The data on monthly volume of fuel sold have two different levels of aggregation. For the Federal District, the data contains the monthly volume of each fuel that each station purchased from each distributor. For every other municipality, the monthly volume data is aggregated at the municipality level and thus contain the volume of each fuel sold by each

[39]Since ANP execute a survey in each market, the identity of the stations that are surveyed may vary from week to week but eventually every station is surveyed. The sample coverage varies according to the size of the municipality. For large capitals, the sample covers between 10% and 25% of all gas stations. For small municipalities, the sample covers between 40% and 50% of all gas stations.

distributor in every given municipality.

We complete our data by collecting information on the price distributors pay to producers. For gasoline, Petrobras makes available the location of every supply point in the country and the monthly average price it charged distributors in each point. For ethanol, we collect the monthly average ethanol price in distilleries from ESALQ. With these data, we have enough information to construct a reasonable measure of marginal cost for distributors.

To construct the sample used in our analysis, we keep the Federal District and the state capitals that are not located in Brazil's north region. We do so because with the Amazon jungle, the capitals of states located in Brazil's north region have an atypical fuel distribution when compared to the rest of the country. Our final sample covers the period from 2010 until 2018 and contains the Federal District and eighteen state capitals.

Horizontal Strategies used by the Cartel

We build on the documents and the data to provide a detailed characterization of the strategies used by retailers to solve the coordination, enforcement and entry problems.

Leadership

According to the documents and the plea bargain deal, any change in the retail prices proceeded as follow:

1) The operations manager from the Cascol group was informed by distributors' sales representatives on any significant change in the next week wholesale price;

2) Based on this information, Cascol decided on the new retail price to be charged by its stations and other members of the cartel;[40]

[40]Usually a few other members of the cartel were consulted by Cascol on what the next retail price

3) Before changing the price at the beginning of the next week, Cascol informed the new prices to the members of the cartel;

4) The other members were responsible for transmitting the information to stations in their vicinity. The new retail prices were posted on the beginning of the next week;

5) Cascol's employees drove around the city to make sure that the other stations were following the accorded price.

The modus operandi of the cartel indicates that Cascol is the responsible for coordinating price changes. The presence of a leader is important when we consider that heterogeneous retailers would have preferences for different collusive prices. As such, Cascol acts to reduce the negotiation and bargaining costs between stations during the decisions of the focal point.[41] It also deal with most of the monitoring costs involved in the coordination, an aspect difficult to be incorporated by small network owners.[42] Even so, because of the large size of the market, Cascol relied on the help from geographically disperse members for the transmission and monitoring of information.

Horizontal transfers

Coordination among asymmetric firms requires them to implement implicit or explicit transfers between participants (Jacquemin and Slade, 1989). The mechanism used by the cartel members to implement implicit horizontal transfers is highlighted on the depositions. According to the cartel members, a group of retailers were allowed to charge 2 to 3 cents below the price proposed by Cascol.[43]

Figure C1 captures the transfer mechanism used by stations to stabilize the cartel. The light bars display the distribution of retail prices minus the minimum

should be. But it is clear from the documents that no decision on the retail price was made without the consent from Cascol managers.

[41] Byrne and De Roos (2019) show the importance of leadership in price coordination for a collusion in the Australian gasoline retail market.

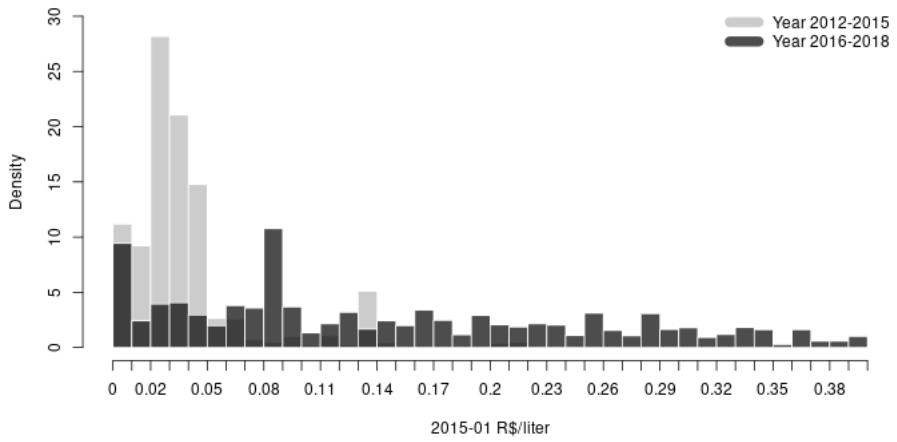
[42] Quotes 3 and 4 on appendix E exemplify the benefities of having Cascol as a leader.

[43] Quote 1

retail price in the week, from 2011 to 2015. From the histogram, it is evident that most prices were chosen to be 2 to 3 cents above the minimum price in any given week. Figure C2 displays an analogous histogram, but considers the distribution of wholesale prices minus the minimum wholesale price in the week. Notice that both the spectrum and decay in frequency are different from the ones in figure C1. These patterns rule out cost explanations for the retail pricing patterns in figure C1.

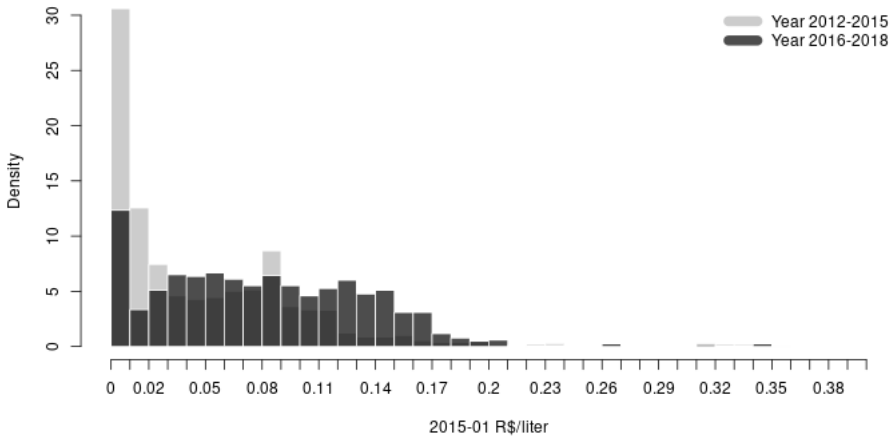
Furthermore, we investigate if this pattern is in place after the antitrust authority intervened in the market. To this end, the dark bars displays the analogous distribution for prices during the years of 2016, 2017 and 2018. Notice that after the intervention, the distribution of retail price differences from the minimum does not have a peak on the value agreed by the cartel and have a much larger support.

Figure C1. Difference of Gasoline Retail Price to Week Minimum Price



Motivated by the evidence presented in figure C1, we investigate the identity of the stations that were charging the minimum price in any given week. These chains are characterized by operating only unbranded stations or having business

Figure C2. Difference of Wholesale Price to Week Minimum Price



other than fuel sale as their main activity (car rental for example). Their distinct characteristics probably imply differences in marginal cost, and consequentially higher gains if deviating from the accorded price. As expected, we find that these stations belong to the chains cited in the depositions as the ones that were allowed to set retail prices below the one proposed by Cascol. Interestingly, this feature of the cartel in the Federal District is similar to the cartel studied in Clark and Houde (2013), where stations with business other than fuel sale (big-box retailers) also benefit from cartel's transfers.

Political machinations and Entry

Table C1 displays the number of stations and the number of new entrants from 2007 to 2018. We observe a steady increase in the number of stations from 2007 until 2011. The entry rate declines in 2012 and there is almost no change in the number of stations until 2016. In 2017, after the cartel was dismantled, the number of stations starts to grow again.

Despite the rents generated by the cartel, the entry patterns highlighted in

Table C1—Number of stations and entry in the Federal District

Year	2007	2008	2009	2010	2011	2012
Number of Stations	253	262	277	283	289	303
New stations from entrants	14	11	12	6	7	4
Car fleet per station	2,738	2,866	2,902	3,056	3,218	3,248
Year	2013	2014	2015	2016	2017	2018
Number of Stations	307	308	307	304	309	324
New stations from entrants	4	5	2	2	7	17
Car fleet per station	3,411	3,594	3,753	3,908	3,940	3,861

Notes: Number of stations refer to the total number of stations register as active in ANP during December of that year. A station is allocated to a group by its initial 8 digits of the cnpj, or when it has a group brand name as part of the register name. We define an entrant as a group that does not have stations in the FD during the previous year.

table C1 show that the period in which the cartel was operational is also the period in which almost no entry is observed. The conversations captured by the wiretaps, and the documents obtained by the police suggest one potential explanation for the entry patterns:[44] that incumbent retailers could have blocked the entry of new firms was by relying on political connections with members of the local government.[45]

There are strict zoning laws regulating land use in the Federal District, specially in Brasilia, and the local government owns most of the current land that could be used to open new stations. On January 29th of 2015, the local government offered for sale a land tract located in the downtown area. The land tract was listed as an area proper for the installation of a gas station. On February 6th, two members of the cartel exchanged text messages regarding the sale of this land tract.[46] During the text exchange, one of the cartel members told the other that he contacted the Governor in order to dissuade him from selling the land tract. According to the cartel member the Governor accepted the suggestion right away.

The conversations between the cartel members are hearsay and it is not a legal proof that the Governor was involved in any wrong doing. But, as a matter of

[44] Another explanation is the macroeconomic conditions at the time. Brazil entered into a recession in 2015, and we can observe a lower growth on the total number of gas station also in some state capitals.

[45] Magnolfi and Roncoroni (2016) is an example on how political connections can affect market structure and perpetuate incumbents dominant position.

[46] Telephone Report number 16.

fact the land was removed from the sales process without any justification. The documents also indicate that members of the cartel kept track of legislative bills that potentially impacted incumbent gas stations and had frequent meetings with aldermen. Moreover, information on political campaigns show Cascol as a large donor to local politicians.[47]

Synthetic Control

We follow Abadie and Gardeazabal (2003) and Abadie, Diamond and Hainmueller (2011) synthetic control approach to evaluate the markup charged by the cartel. The method allows for a data-driven control group selection and is specially suitable when there is a small number of treated units.[48]

The outcome of interest Y_{FD} is the federal district's fuel supply chain markup, and we want to estimate the difference between potential outcomes $\alpha_{FD,t} = Y^{C}_{FD,t} - Y^{B}_{FD,t}$ for months t between 2011 and 2015, where C stands for a cartelized competitive conduct and B for a competitive one. Let X_{FD} a $k \times 1$ matrix with the fuel market characteristics from the Federal District, including the retail and wholesale markup in the post-cartel period 2016-2018. Let X_0 a $k \times 19$ matrix with the same characteristics, but for the state capitals. For a given symmetric and positive semidefinite matrix V, we solve for a vector of control unit's weights W^* that minimizes:

$$\sqrt{(X_{FD} - X_0 W)' V (X_{FD} - X_0 W)}$$

We use Abadie and Gardeazabal (2003) data-driven procedure and choose a V^* that minimizes the mean squared prediction error of the outcome variable over the pre-intervention time period (post-cartel period). Let Z_{FD} the vector

[47] During the 2014 elections Cascol donated more than two hundred thousand reais to local politicians. This figure makes then one of the largest individual donors.

[48] Our implementation at the statistical software R use the prebuild package **Synth**, http://CRAN.R-project.org/package=Synth

of supply chain markups for the Federal District during 2016 to 2018 and Z_0 the analogous for the state capitals, V^* minimize

$$(Z_1 - Z_0 W^*(V))'(Z_1 - Z_0 W^*(V))$$

across the set of positive definite diagonal matrices.

Table D1—Synthetic Control Weights

Market	Weight	Market	Weight
AL-MACEIO	0.001	PE-RECIFE	0.002
BA-SALVADOR	0.122	PI-TERESINA	0.003
CE-FORTALEZA	0.005	PR-CURITIBA	0.003
ES-VITORIA	0.223	RJ-RIO DE JANEIRO	0.006
GO-GOIANIA	0.005	RN-NATAL	0.003
MG-BELO HORIZONTE	0.365	RS-PORTO ALEGRE	0.004
MS-CAMPO GRANDE	0.001	SC-FLORIANOPOLIS	0.243
MT-CUIABA	0.001	SE-ARACAJU	0.006
PB-JOAO PESSOA	0.002	SP-SAO PAULO	0.005

Table D2—Synthetic Control Balance

	Treated	Synthetic	Sample Mean
Car Fleet/Population	0.412	0.412	0.329
Car Fleet/Number of Stations	3,971	3,403	2,327
Median tank size	30	29.946	27.774
Avg. Number of Oppo (3km)	15.454	22.884	30.536
Percent bifuel cars	0.517	0.517	0.460
Markup retail post-cartel	0.106	0.098	0.106
Markup wholesale post-cartel	0.060	0.060	0.051

In table D1 we show the resulting choice of weights, and highlight that our synthetic control is a combination of mainly four state capitals. In table D2 we compare outcome predictors' average between treated, synthetic control and all control units. Although the treated unit is still outside of the convex hull formed by the control, specially in the distance between stations characteristic, the synthetic approach does create a better approximation to the treated unit. Figure 3 compare markups between treatment and control for the period during and after the cartel, and decompose it in retail and wholesale effects. The estimate

treatment effect is the difference between the Supply Chain lines during the cartel periods.

Table D3—Synthetic Control Placebo Test

	Retail		Wholesale		Supply Chain	
	Markup	Price	Markup	Price	Markup	Price
DF-BRASILIA	0.022	0.072	0.032	0.093	0.049	0.162
BA-SALVADOR	0.017	0.054	-0.025	-0.067	-0.006	-0.018
CE-FORTALEZA	-0.012	-0.036	-0.001	-0.004	-0.012	-0.038
PB-JOAO PESSOA	-0.019	-0.057	-0.017	-0.047	-0.034	-0.101
AL-MACEIO	0.009	0.031	-0.005	-0.015	0.004	0.015
PE-RECIFE	0.032	0.102	-0.004	-0.011	0.027	0.088
PI-TERESINA	-0.009	-0.027	-0.001	-0.003	-0.010	-0.028
RN-NATAL	0.005	0.017	0.020	0.055	0.022	0.071
SE-ARACAJU	0.003	0.009	0.001	0.002	0.003	0.010
GO-GOIANIA	-0.010	-0.031	-0.007	-0.019	-0.015	-0.048
MT-CUIABA	0.010	0.034	0.015	0.043	0.022	0.076
MS-CAMPO GRANDE	0.012	0.039	0.024	0.068	0.033	0.106
ES-VITORIA	-0.011	-0.035	0.012	0.036	0.001	0.003
MG-BELO HORIZONTE	-0.010	-0.029	0.002	0.005	-0.008	-0.023
RJ-RIO DE JANEIRO	-0.009	-0.029	-0.010	-0.030	-0.017	-0.058
SP-SAO PAULO	0.008	0.025	0.003	0.009	0.010	0.032
PR-CURITIBA	-0.005	-0.014	-0.017	-0.048	-0.019	-0.060
RS-PORTO ALEGRE	-0.003	-0.010	0.010	0.029	0.006	0.020
SC-FLORIANOPOLIS	0.008	0.025	0.003	0.009	0.010	0.033

Notes: Row names refer to the market used as treated unit. Numbers refer to the average difference between treated and synthetic control during the period 2011-2015.

As a placebo test, we run the exercise described above but using state capitals as the treated unit. In table D3 we show the average treatment effect on both markup and prices, and decompose them into retail and wholesale effects. Looking at the Supply Chain-Markup column, we can not find a treatment effect higher than the one for Brasilia.

Police documents' quotes

We provide the quotes that were obtained directly from the case documents, and the English translation of each quote.

Quote 1 - *General Manager and owner of Cascol, plea bargain*

"Que os postos bandeira branca, como os do Jarjour, do Alemão Canhedo e do Marco Crioulo, também

participavam da combinação de preços do cartel, mesmo adquirindo combustível por um preço mais baixo; **Que, como parte da combinação de preços, os postos bandeira branca do Jarjour, do Alemão Canhedo e do Marco Crioulo praticavam preço de bomba com a diferença de R$ 0.02 (dois centavos), para baixo, em relação aos postos bandeirados.**"

"Even though the unbranded stations belonging to Jarjour, Alemão Canhedo and Marco Crioulo, paid a lower price for fuel, they were also part of the price fixing agreement. **As part of the agreement, they were able to set a price two cents below the price set by other stations.**"

Quote 2 - *General Manager and owner of Cascol, plea bargain*

"o objetivo da BR Distribuidora e da Ipiranga, nas chamadas 'guerras de preços', era de que o posto que iniciou a 'guerra de preços' não conseguisse manter o valor abaixo do preço acordado pelos concorrentes,sendo obrigado a alinhar o valor de venda dos combustíveis aos dosdemais postos, não desestabilizando o acordo e, por consequência,mantendo a alta lucratividade das distribuidoras, como mencionado acimapelo depoente;Que as companhias não davam ao revendedor quehavia iniciado a 'guerra de preços' o desconto dos R$ 0.10 (dez centavos) que davam aos demais revendedores para enfrentar a'guerra de preços'... Que nos eventos de 'guerra de preços' aconteciade tanto a BR Distribuidora quanto a Ipiranga subsidiarem os postos paraforçar a elevação do preço do 'posto rebelde' (...)."

"BR and Ipiranga goal during the 'price wars' was that the station that initiated the war couldn't sustain a price below the price set by the cartel members. This way, the station that initiated the war would have to realign their prices with the price set by cartel members and would not destabilize the agreement. Therefore, the high profitability of fuel distributors would not be affected. Fuel distributors did not give the station the initiated the price war the 10 cents discount they gave to other stations in order for them to face the 'price war'. That during 'price war' events, both BR and Ipiranga would subsidize retailers so they could force the 'rebel retailer' to raise prices again (...)."

Quote 3 - *General Manager and owner of Cascol, plea bargain*

"(...) Que, no início da combinação de preços, todos os revendedores participavam dessas reuniões (do sindicato), 'não tinha quem não participasse', mas havia 'os cabeças', ou seja, as pessoas boas de fazer conta, dentre elas o Cláudio Simm, José Carlos Ulhôa, pessoas da diretoria da Cascol, o Marcelo Dorneles, da rede JB, que indicavam qual era o preço ideal e submetiam a proposta de preço à aprovação de todos, sendo tomada, por unanimidade, a decisão do preço a ser praticado (...)" (termo de declarações no 01, juntado aos autos no 2017.01.1.024068-6).

"(...) In the beginning of the price fixing arrangement all retailers met at the trade association; all retailers took part, but the leaders, the ones that were good doing the math - Cláudio Simm, José Carlos

Ulhôa, people from Cascol management board, Marcelo Dorneles from JB - were the ones indicating the ideal price to be approved by all other retailers. In case of an unanimous decision, the price was set by all stations (...)" (affidavit 01, document 2017.01.1.024068-6).

Quote 4 - *General Manager and owner of Cascol, plea bargain*

"(...) Que, depois, a combinação de preço ficou praticamente automática, ocorrendo quando havia uma modificação do preço, seja em decorrência de um aumento da companhia, seja em razão de outro fator qualquer, como aumento de imposto; Que nesse período, não havia mais necessidade dos revendedores se reunirem para combinar o preço, sendo o ajuste feito de outras formas, como por telefonema, mediante um encontro, e envolvendo poucas pessoas, como, por exemplo, contato do depoente com Cláudio Simm e José Carlos, ou contato de Cláudio Simm e José Carlos, ou por provocação de outro revendedor, havendo a divulgação, normalmente por telefone, para os demais revendedores, numa espécie de 'corrente' ... Que os empregados da Cascol não participavam das decisões sobre a formação dos preços, tendo a incumbência de divulgar esses preços, ou seja, eram 'mensageiros', tanto que, às vezes, traziam sugestões de preços de outros revendedores (...)" (termo de declarações no 01, juntado aos autos no 2017.01.1.024068-6).

"(...) After a while, the price fixing became automatic, with price changes happening when there was an increase in the price set by distributors, or a change in other external factors, like a change in taxes. During this period, there was no need for retailers to meet in order to fix prices, the price adjustments were made through phone calls or small meetings involving the cartel leaders - e.g. the meeting of the deponent with Cláudio Simm and José Carlos, or the contact exchange between Cláudio Simm and José Carlos - or when provoked other retailer. Usually, the message was transmitted by phone to other retailers in some sort of communication chain... That Cascol employees were not part of the meetings in which prices were defined. Their only task was to spread the news, in other words, they were only messengers. This is so, that sometimes they even brought back price suggestions from other retailers (...)" (affidavit 01, 2017.01.1.024068-6).

Quote 5 - *Cascol employee, plea bargain*

"(...) os pequenos aumentos feitos pelas distribuidoras tornam difícil o repasse para a bomba, por várias razões, uma delas é que a Gasol poderia aumentar na própria bomba, mais ficaria difícil passar para os concorrentes, por exemplo, um aumento de R$0,02 (dois centavos), porque alguém poderia não aceitar, e daí causar um desequilíbrio no mercado entre os postos revendedores (...)" (termo de declarações no 05, juntado aos autos no 2017.01.1.024070-8).

"(...) small increases made by fuel distributors are not easy to be passed on the fuel pump, among the many reasons, one is that Gasol (Cascol) could increase their own price, but not necessarily the competitors would accept to do the same. For example, someone could not accept an increase of 2

cents and then generate a disequilibrium between retailers in the market between (...)" (affidavit 05, 2017.01.1.024070-8).

Quote 6 - *Police report referring to wiretap evidence*

"Com o mesmo propósito de impor barreiras à concorrência, dessa feita a representada pelo combustível etanol em relação à gasolina, o denunciado Cláudio Simm expôs a terceira pessoa, via conversação pelo aplicativo WhatsApp, a preocupação do chamado "cartel" com a possibilidade de aumento de venda de etanol no Distrito Federal, e consequente redução de volume de venda de gasolina, em razão da proposta do GDF de reduzir a alíquota de ICMS sobre o álcool combustível, pedindo que a mensagem chegasse ao conhecimento do então Secretário de Fazenda do Distrito Federal."

"With the goal to impose barriers to competition, in particular the competition gasoline faces from ethanol, the defendant Cláudio Simm talked to a third party that the "cartel" was worried about how a state government plan to reduce the tax rate levied on ethanol would incentivize consumers to purchase ethanol and cannibalize gasoline sales. He told the third party that his concerns should reach the Federal District Secretary of Treasury."

Quote 7 - *Police report referring to wiretap evidence*

Segundo consta dos autos, Antônio Matias (rede Cascol), em 19.10.2018, em conversa com funcionário da BR Distribuidora, reclama da diferença entre os preços dos combustíveis, inclusive do etanol, praticados entre essa distribuidora e a Ipiranga. Nessa conversa, Antônio Matias afirma ter entrado em contato com a Ipiranga e solicitado dessa distribuidora que subisse seus preços, supostamente para eliminar a mencionada diferença entre os preços de distribuição

According to the case files, in October 19th 2018, Antônio Matias (Cascol) talks to a BR employee about wholesale prices. Antônio Matias complains about the difference in wholesale prices set by BR and Ipiranga for both gasoline and ethanol. In this conversation, Antônio Matias states that he got in touch with Ipiranga and asked them to increase prices, allegedly to eliminate the aforementioned wholesale price difference.

Quote 8 - *Police report referring to wiretap evidence*

Em diálogo que manteve com revendedor local, o assessor comercial da distribuidora BR Márcio Barreiros, então subordinado, no Distrito Federal, ao denunciado Adão do Nascimento, quando questionado porque a BR estava praticando preços elevados para o etanol, admitiu que a companhia elevava o preço do produto para "acompanhar" a gasolina, bem como porque a BR não tinha interesse em vender álcool.

In a conversation with a local retailer, Márcio Barreiros, a BR employee under the supervision of the

defendant Adão do Nascimento, when asked why BR was setting such high prices for ethanol, replied that BR set ethanol prices 'following' gasoline and that BR was not interested in selling ethanol.

Quote 9 - *Police report referring to wiretap evidence*

"(...) Considerando que o etanol, com a popularização dos carros flex, tornou-se um produto substituto à gasolina, passou a ser necessário controlar o etanol para evitar que os consumidores substituíssem a gasolina por etanol. Pelo visto, a forma de controlar encontrada pelo cartel foi inviabilizar o álcool, colocando-o em preços muito acima dos custos. O preço do etanol é prejudicial ao cartel em razão da variação de preços durante o ano" (Veja-se relatório final da autoridade policial, juntado às fls. 2183/2688, vols. 9 a 11, do IPL 0889/2010, especialmente à fl. 2660)

"(...) Considering that with the diffusion of bifuel cars, ethanol became a substitute to gasoline, it was necessary to control the price of ethanol to avoid consumers to substitute gasoline for ethanol. Apparently, the cartel alternative found by the cartel was to raise the price of ethanol to a point that it would not be worthwhile for consumers. The price of ethanol is detrimental to the cartel because of its variation throughout the year." (Police report, 2183/2688, vols. 9 to 11, IPL 0889/2010).

Quote 10 - *Police report referring to seized document*

Sobre os preços de bomba sugeridos pela Shell constantes da imagem, cabe registrar que, no dia 02/02/2015, a distribuidora Raízen antecipava para seus revendedores, a título de "preço sugerido de bomba", o valor de R$ 3,54 (três reais e cinquenta centavos), preço este que foi efetivamente combinado e implementado pelos integrantes da organização criminosa.

Regarding the prices suggested by Shell and documented in photographs, it should be registered that in 02/02/2015, Raízen displayed to its stations a suggested price of R$ 3,54. This price was the effective price implemented by the members of the criminal organization.

Quote 11 - *Wiretap - Dialogue between Station Owner and Manager regarding the motivations for starting a price war.*

Ricardo: Mas vem cá, o povo (outros postos de gasolina) não tá enchendo o saco não véi?
Rivanaldo: Ta mas é o seguinte eu falei aqui que preciso daquela diferença no preço né?
Ricardo: Mas e quanto que é?
Rivanaldo: Mas não querem, eu quero só 2 centavos, igual deixou o Alemão muito tempo.
Ricardo: Dois?
Rivanaldo: É, e eles não querem deixar, falei então vai pra puta que pariu filho da puta.

Ricardo: Come on, aren't the other stations complaining?

Rivanaldo: They are, but I told them I need that price difference, right?

Ricardo: How much is it?

Rivanaldo: But they don't want, I only want 2 cents, just like Alemão had for a long time.

Ricardo: Two?

Rivanaldo: Yes, and they don't want, so I told those sons of bitches to fuck off.