

Stockholm Institute of Transition Economics

WORKING PAPER

October 2019

No. 51

Corrupting Cartels:
An Overview of the Petrobras Case

Kleno Barbosa and Giancarlo Spagnolo



**STOCKHOLM INSTITUTE OF
TRANSITION ECONOMICS**

Working papers from Stockholm Institute of Transition Economics (SITE) are preliminary by nature, and are circulated to promote discussion and critical comment. The views expressed here are the authors' own and not necessarily those of the Institute or any other organization or institution.

Corrupting Cartels: An Overview of the Petrobras Case¹

Klenio Barbosa^{*}

Giancarlo Spagnolo[♠]

October 25, 2019

Abstract

This paper provides an overview of the corruption case and the connected cartels that affected one of the biggest Brazilian state-owned companies, Petrobras, and the highly controversial 'Operation Car Wash'. We focus on the behavior of cartel members and study the size of the contracts affected or potentially affected by the illegal activity, comparing them with comparable sets of contracts selected with three different matching approaches.

¹ We are grateful to the Swedish Research Council for financial support (Vetenskapsrådet 2014-03007).

^{*} SKEMA Business School - Université Côte d'Azur.

[♠] SITE - Stockholm School of Economics, Tor Vergata, EIEF, and CEPR.

1 Introduction

The state-owned oil company Petrobras went under investigated in 2014 for activities related to corruption and cartel formation. According to the Federal Police and the Public Prosecution Office, 140 billion Brazilian reais, equivalent to 2.5% of the country's GDP, were diverted from the company in a scheme involving construction companies, Petrobras employees, and politicians.

This paper aims to describe the corruption case and the connected cartels that affected one of the biggest Brazilian companies by analyzing how the cartel members acted and the contracts affected or potentially affected by the illegal activity.

To do so, the contracts won by cartel members are compared with those won by non-cartel members.² This procedure is done using three types of matching. The first uses the description of the object or service purchased and the economic activity of the winner firm. The second matching procedure employs an additional variable, namely, the type of legal awarding procedure applied in the hiring process. Finally, in the third approach we use structured text analysis of the description of the object or service to ensure that the contracts won by cartel members are comparable to those won by non-cartel members.

Based on the first matching approach, we find that the mean value of the matched contracts won by cartel members is 222 million reais, while the mean value of the matched contracts won by non-cartel members is 2.449 millions reais. In other words, the value of contracts won by cartel members is 90 times larger than those granted to non-cartel members. The estimations based on the second matching method also indicate that the value of contracts won by cartel members is substantially larger than those granted to non-cartel members. The estimated mean value of the contracts won by cartel members is 53.4 million reais, while the mean value of the contracts won by non-cartel members is 1.953 million reais (i.e., 27 times larger). Finally, the estimation based on the third matching approach also suggests that the value of contracts own by cartel members is much larger (by a factor of 18.3) than those granted to non-cartel members (33.6 million reais versus 1.838 million reais).

The remainder of this chapter is organized as follows. Section 2.2 provides background information on 'Operation Car Wash'. Section 2.3 describes the Petrobras case, Section 2.4 discusses the contracts affected or potentially affected by the cartel activity, and Section 2.5 describes the relevant institutional background. Section 2.6 presents the database, Section 2.7 describes the empirical approach, and finally Section 2.8 reports the results. Appendix 2.A presents and describes the variables in our data set.

² Police and prosecutors have collected proof of the existence of cartel, which are part of lawsuits, CADE reports on the cartel history of conduct, and of the leniency agreements signed by the cartel members Odebrecht, Setal-SOG, UTC, Camargo Correa, Techint, Andrade Gutierrez, Mendes Júnior, Promon and MPE.

2 Institutional Background: Operation Car Wash

In march 2014, the Brazilian Federal Police and the Public Prosecution Office commenced Operation Car Wash (*Operação Lava Jato* in Portuguese), the biggest Brazilian investigation against corruption and money laundering to date.³ The name refers to the fact that the original case was related to the use of a network of gas stations and car washes to operate illegal resources, specifically to launder crime profits.

The first phase of the operation resulted in 28 arrests, including four black-market money dealers: Nelma Kodama, Raul Srour, Carlos Habib Chater, and Alberto Youssef. Following the investigation, the Public Prosecution Office found a link between Youssef and Paulo Roberto Costa, former director of refining and supply at Petrobras, a state-owned oil company. This connection led to Costa's arrest for the first time and the beginning of the inquiry into the state-owned firm.

According to the Public Prosecution Office, the volume of resources diverted from Petrobras reached 140 billion reais (approximately 35 billion US dollars). The same source suggests that the scheme lasted at least ten years and involved construction companies, Petrobras employees, financial intermediaries (responsible for bribe payments and for laundering the money), and public agents (including politicians).

The investigation indicates the existence of crimes related to corruption, cartel activity, money laundering, illegal campaign donations (*Caixa Dois* in Portuguese), bribery, and kickbacks.

Essentially, the scheme operated as follows. Construction companies organized themselves into a cartel instead of competing against each other in bidding for Petrobras contracts. In doing so, they were able to charge non-competitive prices and achieve higher profits in procurement contracts with Petrobras. This process happened with the help of Petrobras' executive managers. For instance, the winner of each Petrobras contract was agreed between Petrobras' managers and the cartel members before that tender occurred. Cartel firms also had inside information on the goods and services that Petrobras planned to procure. In addition, as the Brazilian Procurement Act (Lei das Licitações 8.666/93) gives Petrobras discretion to invite whoever it chooses to place a bid in their procurement auctions, the company ended up only inviting cartel members to bid in the procurement auctions, which made it easier for them to coordinate. After winning, companies distributed between 1% and 5% of the value of the contracts to Petrobras executives and to politicians. The money was delivered through financial intermediaries. These agents were responsible not only for arranging the payment but also for delivering "clean" money.

³ Reference: <http://www.mpf.mp.br/grandes-casos/caso-lava-jato/entenda-o-caso> and <http://www.mpf.mp.br/grandes-casos/caso-lava-jato/atuacao-na-la-instancia/parana/linha-do-tempo>

3 The Petrobras Case

The Brazilian antitrust authority (Conselho Administrativo de Defesa Econômica, or CADE) instigated an inquiry in October 2014 to investigate the case of corruption and the cartel related to Petrobras.⁴ The process focused on the formation of the cartel formation, how it acted, the firms involved, and the contracts affected by the practice.

According to CADE, preliminary cartel practices began in 1998 or 1999 and lasted until 2002. During these years, the firms Iesa Óleo e Gás, Mendes Júnior Trading Engenharia, MPE Montagens e Projetos Especiais S.A., Setal Engenharia e Construções S.A., Techint Engenharia e Construção S.A., Tenenge (bought by Construtora Norberto Odebrecht S.A.), and Ultratec (now called UTC Engenharia S.A.) organized sporadic meetings to discuss the market situation.

The investigation suggested that the cartel actually initiated its activity between 2003 and 2004 with an agreement between nine firms that were authorized by Petrobras to provide the oil company with services related to large-scale industrial assembly. This “club of 9” was composed of the firms Camargo Corrêa S.A., Construtora Andrade Gutierrez S.A., Construtora Norberto Odebrecht S.A., Mendes Junior Trading Engenharia, MPE Montagens e Projetos Especiais S.A., Promon Engenharia Ltda., SOG Óleo e Gás, Techint Engenharia e Construção S.A., and UTC Engenharia S.A.

The cartel began to expand the number of participants between 2006 and 2007. During this period, seven new firms joined the cartel: Construtora OAS S.A., Engevix Engenharia, Galvão Engenharia S.A., GDK S.A., Iesa Óleo e Gás, Construtora Queiroz Galvão S.A., and Skanska Brasil Ltda. This new group constituted the “club of 16”.

Since firms other than cartel members were invited to participate in the bids, the “club of 16” sporadically accommodated other participants. The CADE listed Alusa Engenharia (now called Alumini Engenharia S.A.), Carioca Christiani Nielsen Engenharia S.A., Construcap CCPS Engenharia e Comércio S.A., Fidens Engenharia S.A., Jaraguá Engenharia e Instalações Industriais Ltda., Schahin Engenharia S.A., and Tomé Engenharia S.A. as companies that sometimes adopted an anticompetitive posture in accordance with cartel members.

Starting in 2007, some of the largest firms within the cartel and those with more influence inside Petrobras formed a cartel subset. This subgroup, called the “VIP club” or “G6”, was composed of six firms: Camargo Corrêa S.A., Construtora Andrade Gutierrez S.A., Construtora Norberto Odebrecht S.A., Construtora OAS S.A., Construtora Queiroz Galvão S.A., and UTC Engenharia S.A. This group was still part of the “club of 16”, but aimed to ensure that they would be awarded the main contracts for the construction of the Refinery of

⁴ Reference: <https://www.jota.info/wp-content/uploads/2015/12/NT-38—anexo.pdf>

the Northeast (*Refinaria do Nordeste*, or *Rnest*) and the Petrochemical Complex of Rio de Janeiro (*Complexo Petroquímico do Rio de Janeiro*, or *Comperj*).

By the end of 2011, the cartel activity had gradually lost relevance due to an increase in the number of non-cartel firms participating in Petrobras' invited bidding process, the fall in the number of large-scale industrial assembly projects, and difficulties in coordinating the cartel firms.

In a nutshell, CADE's investigations indicate that the cartel was very active from 2003 to 2011, with nine core members and seven members that coordinated their actions in sporadic contracts.

4 Contracts Affected or Potentially Affected by the Cartel

The Brazilian antitrust authority investigation found that at least 16 procurement contracts were affected by the cartel's activities and another 6 were potentially influenced.⁵ The first contract listed by CADE was for the Diesel Hydrotreating Unit of Henrique Lage Refinery (*Refinaria Henrique Lage*, or *Revap - HDT Diesel*), located in São José do Campos (in São Paulo state). The bidding occurred in 2006 when the "club of 9" had already initiated the process of expanding to accommodate the other participants.

CADE began the history of conduct by describing a consortium composed of Camargo Corrêa S.A., Promon Engenharia Ltda., and MPE Montagens e Projetos Especiais S.A., companies that were part of the "club of 9" that won a Petrobras contract for 1.5 millions of reais. CADE suggests that the analysis of this contract is relevant not only because cartel firms won the bidding but also because three companies that later formed part of the "club of 16" – Construtora Queiroz Galvão S.A., Iesa Óleo e Gás (operating as a consortium), and Engevix Engenharia – presented higher bids, acting in accordance with the cartel.

Between 2007 and 2008, Petrobras conducted bidding processes to update the President Getúlio Vargas Refinery (*Refinaria Presidente Getúlio Vargas*, or *Repar*) in Araucária (in the Paraná state). One of these bids, which was related to the Off-sites Gas Hydrodesulphurisation Unit (*Off-sites HDS Gasolina*), was affected by cartel activity. A consortium composed of SOG Óleo e Gás, Mendes Junior Trading Engenharia, and MPE Montagens e Projetos Especiais S.A. won with a bid of 2.254 billion reais.

CADE alleges that another procurement process started in 2007 was affected by cartel activity. According to the inquiry, the consortium Gasvap – composed of Odebrecht, UTC Engenharia S.A. and Promon Engenharia Ltda. – won a contract for the implementation of the Naphtha Hydrodesulfurization (*Hidrodessulfurização de Nafta*, or *HDS Nafta*) and Catalytic Reform

⁵ Reference: <https://www.jota.info/wp-content/uploads/2015/12/NT-38—anexo.pdf>

(*Reforma Catalítica*, or *URC*) units thanks to the cartel. The contract of 804 million reais was signed in March 2008 after a direct purchase hiring process.

At the same year (in 2007), the consortium CMMS – composed of SOG Óleo e Gás, Mendes Junior Trading Engenharia, and MPE Montagens e Projetos Especiais S.A. (who were cartel members) – won the bidding process for the Gasoline Hydro-treatment unit at the Refinery of Paulínia. The value of the winning bid was 696.9 million reais.

In 2008, the consortium CCPR formed of two cartel members – Camargo Corrêa S.A. and Promon Engenharia Ltda. – won a contract for services related to the Coqueamento Retardado (UCR) from the President Getúlio Vargas Refinery unit. CADE found documents suggesting that the cartel members decided in advance which firms would win the bidding process, and that other cartel members presented proposals with higher values to simulate effective competition.

At the end of 2006, Petrobras began the process of implementing the Northeast Refinery Abreu e Lima (*Refinaria do Nordeste*, or *Rnest - Abreu e Lima*). The refinery was intended to produce 230,000 barrels of heavy oil per day and oil derivatives to the domestic market. Due to the scale and complexity of the project, it was split into multiple lots, some of which were related to the cartel's business expertise. Cartel members coordinated in bidding for these lots and won them while charging non-competitive prices. Similarly, in 2004 Petrobras commenced a project to create the Petrochemical Complex of Rio de Janeiro (*Comperj*), to be implemented in three stages: the construction of a refinery, a petrochemical complex, and then another refinery. Given the complexity of the project, the construction involved many bid processes, some of which were influenced by cartel activity. These two projects – *Rnest* and *Comperj* – mark one of the most active periods of the cartel, a period which included the creation of a cartel subgroup – the "VIP club" or "G6" – to win the most profitable contracts.

CADE alleges that at least five contracts related to *Rnest* were affected by cartel activity. These were the contracts for the Resnet Powerhouse (*Casa de Força*, or *CAFOR*), UDA, HDT/UGH, UCR and Off-sites. The process to hire a company to construct the Resnet Powerhouse started in 2007 and was won by Alusa Engenharia, one of the companies sporadically involved in the cartel's activities. The other four contracts, considered the most important ones, were won by members of the "VIP club", acting as consortium members themselves or in partnership with other companies.

A consortium formed of Construtora Norberto Odebrecht S.A. and Construtora OAS S.A. – both companies in the "VIP club" – won the UDA and HDT/UGH contracts. The two contracts were worth 4.7 billion reais (i.e. more than 2.3 billion reais for each firm). The consortium CNCC, composed of Camargo Corrêa S.A. and CNEC (the former a "VIP club" member and the latter owned by the former), won the UCR contract to the value of 3.446 billion reais. Finally, a consortium with Construtora Queiroz Galvão S.A. and Iesa Óleo e Gás (the former a "VIP club" member and the latter a "club of 16" member) won the Off-sites contract to the value of 2.736 billion reais.

CADE's Brazilian antitrust authority investigation shows that other six contracts awarded by *Comperj* were affected by cartel activity: UDA/UDAV, COQUE/UCR, HDT, PIPE RACK, UGH, and UPGN ROTA 3. The cartel members that won these contracts were Construtora Andrade Gutierrez S.A., UTC Engenharia S.A., Alusa Engenharia and Galvão Engenharia S.A.

Additionally, a consortium composed of Skanska Brasil Ltda., Promon Engenharia Ltda. and Engevix Engenharia, all three cartel members, won the contract with *Comperj* UDA/UDAV in 2009 with the value of 1.28 billion reais. In the same year, a consortium formed of Techint Engenharia e Construção S.A. and Construtora Andrade Gutierrez S.A. won a contract with COQUE/UCR with a bid of 2.488 billion reais. As another illustration of cartel activity, a consortium formed of Construtora Queiroz Galvão S.A., Galvão Engenharia S.A. and Iesa Óleo e Gás, also cartel members, won a contract with HDT in 2010 with a value of 987.8 million reais. Following cartel activity, in 2011 a consortium composed of Construtora Norberto Odebrecht S.A., UTC Engenharia S.A. and Mendes Junior Trading Engenharia won the PIPE RACK contract with a value of 1.969 billion reais.

Finally, CADE suggests that in 2013, the cartel members discussed the rule for sharing the contracts relating to UGH and UPGN ROTA 3. The former was won by Toyo/Setal with a bid of 1.12 billion reais, and the latter by a consortium composed of Construtora Queiroz Galvão S.A., Iesa Óleo e Gás and Tecna with a bid of 1.808 billion reais.

The Brazilian antitrust authority lists six other contracts that were potentially affected by cartel activity: for the Duque de Caxias Refinery, for the Bernardes President Refinery, for services related to quality, security and health in units outside of Brazil, for the Cabiúnas Gas Terminal, for the Unit of Nitrogenated Fertilizers in Uberaba-MG, and for Gabriel Passos Refinery in Betim-MG.

5 Relevant Institution Background: Public Procurement Rules and Special Rules for Petrobras

5.1 Public Procurement Rules in Brazil

All public bodies in Brazil (national, state and local) – including direct administration bodies, municipalities, public foundations, state-owned companies, mixed-capital companies and other entities controlled directly or indirectly by the union, states, federal district and municipalities – are subject to the 1993 Public Procurement Act (Law 8,666). The Brazilian Procurement Act delineates procurement procedures for the acquisition of goods, works and services (i.e., inputs) as well as sales of government assets. Note that Petrobras and its subsidiaries, the focus of our investigation, have to comply with most of the national procurement rules. The special procurement rules that apply to Petrobras will be described in the next subsection.

According to the Brazilian Procurement Act, before searching for an input supplier, all public bodies must come up with a clear description of their needs, including a detailed specification of the input, quantity, quality, place and delivery time. In addition, they must make all of this information publicly available in a call for proposals published in an official gazette.

Public bodies usually make purchases in a decentralized way. These are financed by an annual budget assigned to each public body. For this reason, public bodies need to set an estimated budget (known as a reference price) for every product they wish to acquire. There are not explicit rules in the Brazilian Procurement Act that assert how public bodies must estimate the value of products or services being acquired. The guidelines for procurement offices of all public bodies says that for recurrent acquired goods and services, the estimated value of a good or service shall be based on the past acquisitions of the same product. For other goods and services, public bodes shall carry out a public consultation with experts to infer an estimated value. The estimated value may be used as the reservation price in a procurement auction, but this is not always the case. The Brazilian Procurement Act gives the procurement office of public bodies discretion over whether or not to disclose the estimated value and the reservation price in the call for proposals.

Public bodies can use either electronic or physical auctions. Electronic reverse auctions are online on official procurement platforms, with any supplier allowed to submit a bid. The legislation establishes several physical auction mechanisms, ranging from open competitive bidding to invited bidders. It also establishes that all procurement of public inputs must be based on value for money, which is a combination of whole life costs and quality.

Public bodies choose the awarding mechanism according to the monetary value and the type of product or service involved in a procurement transaction. High-value contracts must be awarded through open competitive bidding, while those of lower value can be awarded through restricted bidding.

In the case of engineering works and services, the awarding mechanism to be adopted must respect the following criteria: (i) invited bidding may be used for works and services whose values do not exceed 150,000 reais (around \$37,500); (ii) restricted bidding may be used for works and services whose amounts do not exceed 1,500,000 reais (around \$375,000), and (iii) open competitive bidding may be used for works and services of any value, and is the only mechanism that may be used for works and services whose value exceeds 1,500,000 reais (around \$375,000). Electronic auctions, whose lowest bid is the only criterion for selection of suppliers, cannot be used for engineering works and services.

For public procurement of goods and standard services, the awarding procedure must respect the following criteria: (i) invited bidding may be used for purchases of goods and other services whose value does not exceed 80,000 reais (around \$20,000); (ii) price-taking may be used for purchases of goods and other services whose value does not exceed 650,000 reais (around \$162,500), and (iii) Open Competitive bidding may be used for the purchase of goods and other services of any value, and it is the only mechanism that can be used for purchases and other services whose values exceed 650,000 reais (around \$162,500). Electronic auctions, whose lowest bid is the only criterion for selection of suppliers, can be used for the acquisition of common goods and services of any value.

Public acquisition without competitive bidding is allowed for low-value contracts (direct purchase) or when competition is not possible (ineligibility). The terms of the procurement contract awarded through direct purchase are directly negotiated between the administration and the supplier. Direct purchase can be used to award contracts with a value lower than or equal to 8,000 reais (around \$2,000) to acquire goods and standardized services, and 15,000 reais (around \$3,750) for complex engineering services and construction. Ineligibility can be used to award contracts for products under patent protection or if there is only one seller of the product in the national market. The terms of the procurement contract awarded through ineligibility are also directly negotiated between the administration and the supplier. Electronic auctions can be used to purchase standardized goods and services of any value.

While in electronic reverse auctions, the lowest bid is the only criterion for selection of suppliers, public administrations may use selection criteria other than price-based auction mechanisms when running physical auctions. For instance, they can base their selection decision on best technique (precision, safety, and durability – i.e., quality), or best technique and price. This includes the use of scoring auctions for the acquisition of complex services such as engineering works and projects.

Public procurement legislation establishes that the public bodies must declare in the call for proposals whether consortia bidding and subcontracting are allowed. However, the procurement office of the public body has the discretion over whether or not to allow subcontracting and consortia formation, and to determine the maximum number of members in a consortium.

5.2 Special Procurement Rules for Petrobras

Later on in the 1990s, procurement rules became less strict for Petrobras. A differentiated and simplified regime was created for the company, aimed at speeding up the procedures for hiring suppliers and reducing bureaucracy. Petrobras stopped following the entire set of rules established by the 1993 Brazilian Procurement Act in 1997, when its procurement contracts began to be guided by Decree 2.745 / 98, and in art. 67 of Law 9.478/97.

Among the special rules, a few are crucial for understanding the interactions between the cartel and corruption in the procurement contracts of Petrobras. For instance, Petrobras has the discretion to invite the set of companies (which can be just one company) that it wants to place bids in its procurement auctions. Petrobras also has the right to sign pre-contracts by issuing invitation letters, ensuring prices and commitments to supply goods or services. These more flexible rules allowed Petrobras to only invite cartel members to bid in its procurement auctions, which made it easier for the cartel to coordinate and share Petrobras contracts amongst themselves.

6 Database and Summary Statistics

Petrobras maintains an online database containing information about the contracts signed by the company in the last years.⁶ The database has information on the section of Petrobras

⁶ Available at <http://transparencia.petrobras.com.br/licitacoes-contratos/contratos>

responsible for each purchase, the type of legal awarding procedure used in the purchase, the name and identification number of the supplier, the initial and final date of the contract, the value of the contract, the contract status (active, finished or cancelled), and the identification numbers of any amendments. Table 1 provides a description of the contracts awarded by Petrobras and its subsidiaries. The values of the contracts are presented by legal awarding procedure used to allocate Petrobras contracts.

Table 1: Contracts by Legal Awarding Procedure

	Contracts	% Contracts	Value*	% Value*
Direct Purchase	596,329	88.27%	73.302 B	10.70%
Invited Bidding	41,037	6.07%	415.062 B	60.58%
Ineligibilities	37,160	5.50%	194.628 B	28.41%
Restricted Bidding	930	0.14%	0.028 B	0.00%
Open Auction	102	0.02%	2.012 B	0.29%
Non-Competitive	15	0.00%	0.114 B	0.02%
Total	675,573	100.00%	685.147 B	100.00%

*Values in Brazilian reais updated by Brazilian inflation (IPCA) until September/2018.

Table 2 provides a description of the contracts by legal awarding procedure divided into cartel and non-cartel winners. The table shows that the cartel activity was concentrated in invited biddings, followed in number by direct purchases and ineligibilities.

Table 2: Contracts by Legal Awarding Procedure: Cartel and Non-Cartel Winners

	Contracts	Non-Cartel	% Non-Cartel	Cartel	% Cartel
Direct Purchase	596,329	596,263	99.99%	66	0.01%
Invited Bidding	41,037	40,791	99.40%	246	0.60%
Ineligibilities	37,160	37,126	99.91%	34	0.09%
Restricted Bidding	930	929	99.89%	1	0.11%
Open Auction	102	102	100.00%	0	0.00%
Non-Compet Agr	15	15	100.00%	0	0.00%

Total	675,573	675,226	99.95%	347	0.05%
-------	---------	---------	--------	-----	-------

When the values of the contracts are taken into account, the influence of cartel actions is most prominent in the case of invited biddings. More than 80% of the total value of contracts won by the cartel members was related to this kind of hiring process. The figure of 107.775 billion reais represents more than 25% of the invited bidding expenditures. These results are presented in Table 3.

Table 3: Contract Values by Legal Awarding Procedure: Cartel and Non-Cartel

	Value*	Non-Cartel*	% Non-Cartel	Cartel*	% Cartel
Direct Purchase	73.302 B	58.870 B	80.31%	14.432 B	19.69%
Invited Bidding	415.062 B	307.287 B	74.03%	107.775 B	25.97%
Ineligibilities	194.628 B	185.572 B	95.35%	9.056 B	4.65%
Restricted Bidding	0.028 B	0.028 B	99.95%	0.000 B	0.05%
Open Auction	2.012 B	2.012 B	100.00%	0.000 B	0.00%
Non-Compet Agr	0.114 B	0.114 B	100.00%	0.000 B	0.00%
Total	685.147 B	553.884 B	80.84%	131.263 B	19.16%

*Values in Brazilian reais updated by Brazilian inflation (IPCA) until September/2018.

Table 4 presents the distribution of contracts by year. The table shows that the distribution of contracts is concentrated in more recent years.

Table 4: Contracts by year: Cartel and non-cartel members

Year	Contracts	% Contracts	Value*	% Value*
1994	1	0.00%	0.000 B	0.00%
1998	2	0.00%	6.929 B	1.01%
2000	6	0.00%	15.679 B	2.29%
2001	17	0.00%	6.914 B	1.01%
2002	56	0.01%	17.283 B	2.52%

2003	22	0.00%	0.983 B	0.14%
2004	71	0.01%	51.636 B	7.54%
2005	49	0.01%	8.202 B	1.20%
2006	178	0.03%	21.008 B	3.07%
2007	492	0.07%	47.730 B	6.97%
2008	787	0.12%	74.489 B	10.87%
2009	1,212	0.18%	48.879 B	7.13%
2010	2,527	0.37%	104.250 B	15.22%
2011	5,509	0.82%	85.096 B	12.42%
2012	113,406	16.79%	76.552 B	11.17%
2013	194,043	28.72%	61.800 B	9.02%
2014	179,920	26.63%	35.848 B	5.23%
2015	138,680	20.53%	20.926 B	3.05%
2016	38,595	5.71%	0.941 B	0.14%
Total	675,573	100.00%	685.147 B	100.00%

*Values in Brazilian Reais updated by Brazilian inflation (IPCA) until September/2018.

When considering the timing of events, the distribution of the value of the contracts won by cartel members is clearly concentrated between the years 2006 and 2011. This coincides with the period of greater cartel activity according to the CADE inquiry. These results are presented in table 5 and figure 1.

Figure 1: Cartel and non-cartel winners: proportion of contract value by year

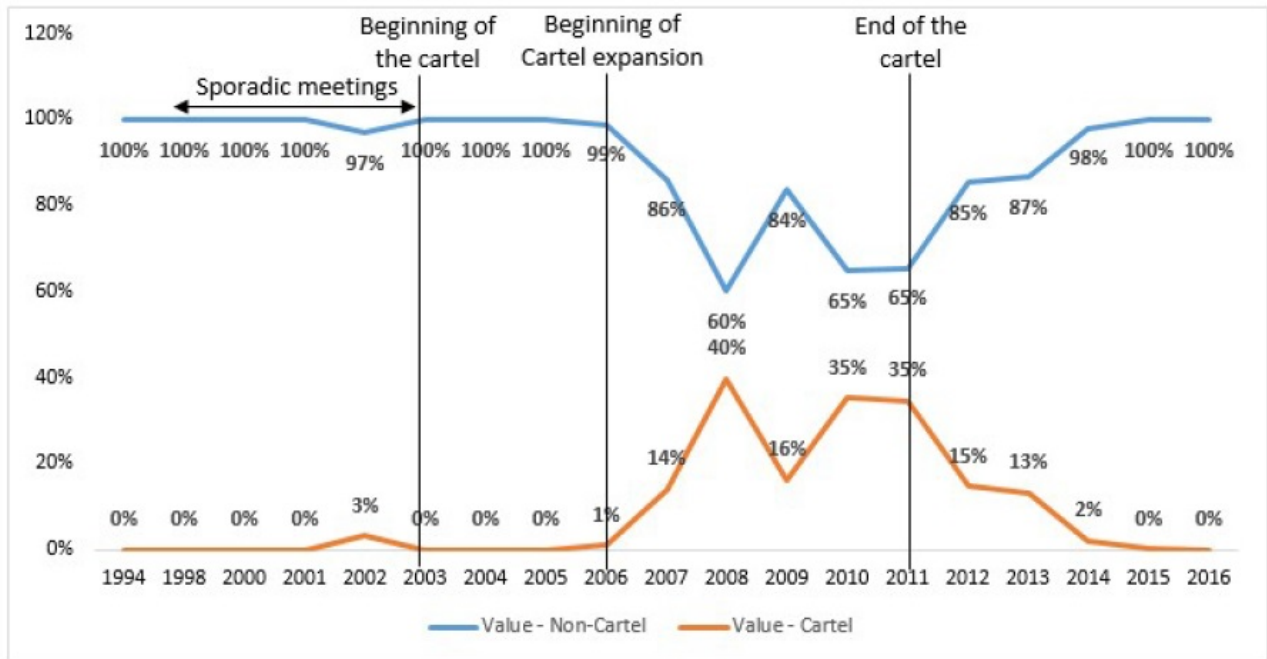


Table 5: Contracts by year: cartel and non-cartel members

Year	Contracts - Non-Cartel	Contracts - Cartel	Value - Non-Cartel*	Value - Cartel*
1994	100.00%	0.00%	100.00%	0.00%
1998	100.00%	0.00%	100.00%	0.00%
2000	100.00%	0.00%	100.00%	0.00%
2001	100.00%	0.00%	100.00%	0.00%
2002	98.21%	1.79%	96.89%	3.11%
2003	100.00%	0.00%	100.00%	0.00%
2004	100.00%	0.00%	100.00%	0.00%
2005	100.00%	0.00%	100.00%	0.00%
2006	98.31%	1.69%	98.91%	1.09%
2007	98.78%	1.22%	86.04%	13.96%
2008	96.19%	3.81%	60.18%	39.82%
2009	98.43%	1.57%	83.75%	16.25%
2010	98.30%	1.70%	64.72%	35.28%
2011	98.77%	1.23%	65.47%	34.53%
2012	99.94%	0.06%	85.38%	14.62%
2013	99.97%	0.03%	86.83%	13.17%
2014	99.98%	0.02%	97.99%	2.01%
2015	100.00%	0.00%	99.95%	0.05%
2016	100.00%	0.00%	100.00%	0.00%
Total %	99.95%	0.05%	80.84%	19.16%
Total Values	675,226	347	553.884 B	131.263 B

*Values in Brazilian Reais updated by Brazilian inflation (IPCA) until September/2018.

Considering only invited biddings, the value of the contracts is higher from 2008 to 2013, as shown in table 6. Table 7 shows that contracts won by cartel members represent a large share of the agreements signed in the same period.

Table 6: Contracts by year: Invited Bidding

Year	Contracts	% Contracts	Value*	% Value*
2001	2	0.00%	6.363 B	1.53%
2002	4	0.01%	8.478 B	2.04%
2003	5	0.01%	0.206 B	0.05%
2004	25	0.06%	17.460 B	4.21%
2005	19	0.05%	7.836 B	1.89%
2006	110	0.27%	14.440 B	3.48%
2007	250	0.61%	19.518 B	4.70%
2008	525	1.28%	48.753 B	11.75%
2009	869	2.12%	36.990 B	8.91%
2010	1,664	4.05%	80.008 B	19.28%
2011	3,076	7.50%	63.828 B	15.38%
2012	8,509	20.73%	55.448 B	13.36%
2013	9,980	24.32%	38.188 B	9.20%
2014	9,562	23.30%	13.016 B	3.14%
2015	5,658	13.79%	4.303 B	1.04%
2016	779	1.90%	0.226 B	0.05%
Total	41,037	100.00%	415.062 B	100.00%

*Values in Brazilian Reais updated by Brazilian inflation (IPCA) until September/2018.

Table 7: Contracts by year: Invited Bidding

Year	Contracts - Non-Cartel	Contracts - Cartel	Value - Non-Cartel*	Value - Cartel*
2001	100.00%	0.00%	100.00%	0.00%
2002	75.00%	25.00%	93.66%	6.34%
2003	100.00%	0.00%	100.00%	0.00%
2004	100.00%	0.00%	100.00%	0.00%
2005	100.00%	0.00%	100.00%	0.00%
2006	97.27%	2.73%	98.41%	1.59%
2007	98.40%	1.60%	88.73%	11.27%
2008	95.24%	4.76%	48.82%	51.18%
2009	98.27%	1.73%	81.59%	18.41%
2010	97.60%	2.40%	54.44%	45.56%
2011	98.15%	1.85%	70.52%	29.48%
2012	99.38%	0.62%	80.16%	19.84%
2013	99.65%	0.35%	82.70%	17.30%
2014	99.86%	0.14%	98.69%	1.31%
2015	100.00%	0.00%	100.00%	0.00%
2016	100.00%	0.00%	100.00%	0.00%
Total %	99.40%	0.60%	74.03%	25.97%
Total Values	40,791	246	307,287 B	107,775 B

*Values in Brazilian Reais updated by Brazilian inflation (IPCA) until September/2018.

Finally, tables 8 and 9 provide a comparison of the percentage of the total value related to cartel members' and non-cartel members' contracts. Despite the fact that the 23 most-frequent non-cartel member suppliers were responsible for 68,595 contracts in the period, the purchases represent less than 0.16% of the total value. This contrasts with the small number of contracts (379) awarded to cartel members representing more than 15% of the purchase value.

Table 8: Contracts by cartel members

Cartel Firm	% Total value*	% Total cartel*	% Contracts cartel**	Contracts
--------------------	-----------------------	------------------------	-----------------------------	------------------

1) UTC	1.77%	9.25%	11.35%	43
2) Odebrecht	1.76%	9.16%	7.39%	28
3) Galvao	1.39%	7.28%	5.54%	21
4) Queiroz Galvao	1.03%	5.36%	8.44%	32
5) Camargo Correa	0.98%	5.09%	1.06%	4
6) OAS	0.83%	4.35%	1.58%	6
7) Alusa/Alumini	0.81%	4.25%	3.69%	14
8) IESA	0.77%	4.02%	3.69%	14
9) Mendes Junior	0.70%	3.65%	1.85%	7
10) Schahin	0.68%	3.54%	6.07%	23
11) Setal/SOG	0.57%	2.96%	1.32%	5
12) Skanska	0.52%	2.71%	6.07%	23
13) Engevix	0.50%	2.63%	2.90%	11
14) Promon	0.49%	2.56%	2.37%	9
15) Jaragua Eng.	0.46%	2.41%	15.30%	58
16) MPE	0.40%	2.10%	5.01%	19
17) Fidens	0.35%	1.83%	2.64%	10
18) GDK	0.33%	1.74%	4.75%	18
19) Construcap	0.31%	1.61%	1.06%	4
20) Andrade Gutierrez	0.29%	1.51%	1.32%	5
21) Techint	0.23%	1.21%	0.79%	3
22) Carioca Eng.	0.18%	0.95%	1.32%	5
23) Tome Eng.	0.17%	0.88%	4.49%	17
Total	15.52%	81.03%	100.00%	379
Total Values	685.147 B	131.263 B	379	

*Values in Brazilian reais updated by Brazilian inflation (IPCA) until September/2018.

**In the case of consortium, the value of the contract was split within the firms. Also, the consortium is considered as many as contracts as the number of firms from the consortium.

Table 9: Top 23 more frequent non-cartel members suppliers

Firm	% Total value*	% Non-Cartel value*	% Cont Non-Cartel	Contracts
1) EMERSON PROCESS MANAGEM	0.0691%	0.086%	0.669%	4,520
2) COMPANHIA DOCAS DO CEARA	0.0150%	0.019%	0.740%	4,994
3) ROYAL RIO PALACE HOTEL LTDA	0.0104%	0.013%	0.329%	2,223
4) COMPANHIA DOCAS DO PARA	0.0084%	0.010%	0.392%	2,650
5) TEADIT JUNTAS	0.0066%	0.008%	0.396%	2,675
6) FOPII COMERCIO E IND LTDA	0.0065%	0.008%	0.315%	2,126
7) ACCOR BRASIL	0.0050%	0.006%	0.834%	5,631
8) TECFLUX LTDA.	0.0049%	0.006%	0.330%	2,231
9) PARKER HANNIFIN IND COM	0.0047%	0.006%	0.328%	2,217
10) CENTELHA EQUIP. ELÉTRICOS	0.0035%	0.004%	0.350%	2,365
11) SCHULZ AMERICA LATINA	0.0028%	0.003%	0.351%	2,372
12) ATLANTICA HOTELS	0.0028%	0.003%	1.073%	7,247
13) DARVA OFFSHORE COM DE MAQ	0.0019%	0.002%	0.380%	2,566
14) DIAGONAL COMERCIO E SERV	0.0018%	0.002%	0.389%	2,626
15) KINO EMPREEND HOTELEIRO	0.0017%	0.002%	0.358%	2,415
16) TRANSAMERICA FLATS	0.0016%	0.002%	0.348%	2,353
17) TELE - RAD ELETROELETRO	0.0014%	0.002%	0.465%	3,141
18) AUTO PASTORE	0.0014%	0.002%	0.332%	2,242
19) MEZZALIRA COM E IMPORTACAO	0.0014%	0.002%	0.308%	2,080
20) JM SUPPLY DO BRASI	0.0010%	0.001%	0.370%	2,496
21) SUDPAR - SUDESTE PARAFUSOS	0.0009%	0.001%	0.400%	2,699
22) RIO DE JANEIRO CARTORIO	0.0005%	0.001%	0.377%	2,543
23) CELI EMPREEND HOTELEIROS	0.0004%	0.001%	0.323%	2,183
Total	0.1539%	0.190%	9.213%	68,595
Total Value	685.147 B	553.884 B	675,226	

*Values in Brazilian Reais updated by Brazilian inflation (IPCA) until September/2018.

7 Empirical Approach

The first task related to the database is to identify the contracts won by cartel members. Despite the fact that the database provided information about the name of the corporate group and the firm's identification number, a preliminary analysis of the contracts won by cartel members was necessary since some of the cartel member business groups were composed of different firms (with different names and potentially distinct IDs). Moreover, given that the establishment of a consortium was common practice, the proper identification of contracts won by cartel members in aggregated groups was mandatory. The results of this preliminary phase are presented in table 10.

Table 10: Division of contracts by frequent and sporadic cartel firms

	Contracts	Value*	% Contracts	% Value*	Cum. Contr.	Cum. Value*
Frequent Cartel Firm**	126	26.418 B	36.31%	20.13%	36.31%	20.13%
Sporadic Cartel Firm***	39	8.962 B	11.24%	6.83%	47.55%	26.95%
Total	165	35.380 B	47.55%	26.95%	47.55%	26.95%
Expanded Frequent Cartel****	55	4.655 B	15.85%	3.55%	63.40%	30.50%
Expanded Sporadic Cartel	68	3.329 B	19.60%	2.54%	83.00%	33.04%
Total	123	7.984 B	35.45%	6.08%	83.00%	33.04%
Consortium of Frequent Cartel	46	78.529 B	13.26%	59.83%	96.25%	92.86%
Consortium of Sporadic Cartel	13	9.370 B	3.75%	7.14%	100.00%	100.00%
Total	59	87.899 B	17.00%	66.96%	100.00%	100.00%
Total	347	131.263 B	100.00%	100.00%	100.00%	100.00%

*Values in Brazilian reais updated by Brazilian inflation (IPCA) until September/2018.

**Frequent: firms that frequently were cartel members

***Sporadic: firms that sporadically were cartel members

****Expanded: firms with the same name as the cartel members, but different IDs because they were registered in different states, and firms from the same cartel member business group

After the identification of the contracts won by cartel members, the analysis focused on identifying contracts with similar characteristics to those potentially affected by cartel activity. Therefore, a matching procedure was employed with treatment meaning that the supplier of the good/service was a cartel member.

This matching procedure was implemented in three ways. In the first matching, which was the least restrictive, the Brazilian Standard Industrial Classification (SIC) of the contract winner firm and the words describing the object purchased were used. The former measure is based on CNAE 2.0 Classe – a Brazilian classification of economic activity. To construct the latter measurement, the variable with the description of the contracts potentially affected by cartel activity was split into its component words. After that, some of the most common connector

words in Portuguese were excluded. Finally, each word became a dummy variable that was equal to one if the description of the purchase (won by a cartel member or not) had that word and zero otherwise.

The second matching procedure employed the former two variables as well as the type of legal awarding procedure used in the hiring process. The third matching is equal to the second with the exclusion of contracts that, after a reading of the object purchase description, result in not being related to the same object.

8 Results

The results from the first matching procedure are presented in tables 11 and 12. The description of 40 contracts won by cartel members were matched with 105 other contracts won by non-cartel members among suppliers from the same SIC. The mean value of the contracts provided by cartel members was 222 million reais, against 2.449 million reais in the case of non-cartel members.

Table 11: Matched and unmatched observations in matching 1

	Control	Treated*	Sum
All	41,549	343	41,892
Matched	105	40	145
Unmatched	41,444	303	41,747

*The SIC of four firms was missing.

Table 12: Matching results in matching 1

	Control	Treated
Mean Contract Value	2.449M	222M
Confidence Interval 95%	[-4,656 - 4.902M]	[13.7M - 431M]
N	105	40

diff = mean(Control) - mean(Treated)
 Test if Ho: diff = 0: t = -3.4723
 Test if Ha: $diff < 0$: $Pr(T < t) = 0.0003$

In the second matching procedure, 31 treated contracts were matched with 89 non-treated contracts. The mean value from the former group is 53.4 million reais, versus 1.953 million reais for the latter. The results are presented in tables 13 and 14.

Table 13: Matched and unmatched observations in matching 2

	Control	Treated*	Sum
All	41,549	343	41,892
Matched	89	31	120
Unmatched	41,460	312	41,772

*The SIC of four firms was missing.

Table 14: Matching Results in matching 2

	Control	Treated
Mean Contract Value	1.953M	53.4M
Confidence Interval 95%	[-477,65 - 4.383M]	[-1.925M - 109M]
N	89	31

diff = mean(Control) - mean(Treated)
 Test if Ho: diff = 0: t = -3.2161
 Test if Ha: $diff < 0$: $Pr(T < t) = 0.0008$

Finally, in the third matching procedure, two contracts were excluded from the treatment group and two from the control group. As a result, the matching produced 29 treated contracts and 87 non-treated contracts. The mean value from the contracts related to firms linked to the cartel activity was 33.6 million reais, and 1.838 million reais in the case of non-cartel members. The results are shown in tables 13 and 14.

Table 15: Matched and unmatched observations in matching 3

	Control	Treated*	Sum
All	41,549	343	41,892
Matched	87	29	116
Unmatched	41,462	314	41,776

*The SIC of four firms was missing.

Table 16: Matching Results in matching 3

	Control	Treated
Mean Contract Value	1.838M	33.6M
Confidence Interval 95%	[-637,75 - 4.314M]	[-4.054M - 71.2M]
N	87	29

diff = mean(Control) - mean(Treated)
 Test if Ho: diff = 0: t = -2.9572
 Test if Ha: $diff < 0$: $Pr(T < t) = 0.0019$

References

Barbosa, K., and Fiuza, E., 2011. "Demand Aggregation and Credit Risk Effects in Pooled Procurement: Evidence from the Brazilian Public Purchases of Pharmaceuticals and Medical Supplies", FGV-EESP C-Micro Working Paper Series.

Barbosa, K. 2015. "The Brazilian Procurement System of Price Registration", in Eduardo Fiuza and Lucia Helena Salgado (editors), *Aperfeiçoando a Qualidade Regulatória*, Rio de Janeiro: IPEA (in Portuguese).

Dimitri, N., Piga, G., and Spagnolo, G., 2006. *Handbook of Procurement*, Cambridge, UK: Cambridge University Press.

Appendix A Data Base Description

The data base provided by Petrobras on the website <http://transparencia.petrobras.com.br/licitacoes-contratos/contratos> has the following information:

Table 17: Information provided in the Petrobras' data base

Original Name	Variable Name in English	Variable Description
Unidade administrativa	Buyer Name	Name of the Petrobras' sector responsible for the purchase
Número do contrato	Contract Number	Identification number of the purchase process
Modalidade da licitação	Legal Awarding Procedure	Type of legal awarding procedure used in the purchase
Fornecedor	Supplier Name	Name of the Petrobras' supplier (winner of the legal awarding procedure)
CNPJ/CPF	Supplier ID	Identification number of Petrobras' supplier (winner of the legal awarding procedure)
Objeto da contratação	Lot Description	Describes the contract object
Fundamento legal	Legal Justification	Legal justification for the legal awarding procedure applied in the purchase
Início da vigência	Start Date Validity	Initial date contract
Fim da vigência	Final Date Validity	Final date contract
Valor do contrato	Contract Value	Describes the value of the contract in the currency used in the purchase
Situação	Status	Describes the contract status: active, finished or cancelled
Número dos aditivos	Amendments	Provides the identification numbers of the amendments if the contract had any amendments

The variable Legal Awarding Procedure in the Petrobras data base is classified as follow:

Table 18: Type of legal awarding procedure

Original Name	Variable Name in English
Dispensa de Licitação	Direct Purchase
Convite	Invited Bidding
Inaplicável or Inexigibilidade	Ineligibilities
Tomada de Preços	Restricted Bidding
Concorrência	Open Auction
Convênios	Non-Competitive Agreements

Table 19: Description of variables

Variable	Description
Buyer	Name of the Petrobras' sector responsible for the purchase
ContractNumber	Identification number of the purchase process
LegalAwardingProcedure	Type of legal awarding procedure used in the purchase. It is classified as follow: <ul style="list-style-type: none"> • Direct Purchase (Dispensa de Licitação) • Invited Bidding (Convite) • Ineligibilities (Inaplicável or Inexigibilidade) • Restricted Bidding (Tomada de Preços) • Open Auction (Concorrência) • Non-Competitive Agreements (Convênios) • Brazilian Law 8666 (contracts approved before the Brazilian Law 2.745 (Decreto nº 2.745) responsible for Petrobras legal awarding procedure regulation)
SupplierNameRaw	Original name of the Petrobras' supplier (winner of the legal awarding procedure)
SupplierID	Identification number of Petrobras' supplier (winner of the legal awarding procedure)
LotDescriptionRaw	Describes the contract object
LegalJustification	Legal justification for the legal awarding procedure applied in the purchase
StartDateValidityRaw	Initial date of contract
FinalDateValidityRaw	Final date of contract

ContractValueRaw	Describes the value of the contract in the currency used in the purchase
Status	Describes the contract status: active, finished or cancelled
Amendments	Provides the identification numbers of the amendments if the contract had any amendments
