OFFSHORE NAVIGATION PRICE FORMATION IN BRAZIL AND THE COST OF MARKET PROTECTION

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Abstract: The Brazilian market for offshore vessels – to support the production of oil in marine waters – is one of the most important in the world. It represents 6% of the world market in number of vessels and 13.3 billion dollars between 2005-2015. This market is characterized as oligopsony, i.e., several sellers concentrated in a few buyers. In this work, the main buyer is Petrobras. The database was obtained from the contracts between the shipping companies and Petrobras, where it is possible to observe the contracted ship, the amounts paid and the duration of the contracts. With this data, the vessel features were researched: model, year of construction and country of registered (flag), Brazilian or not. The National Agency of Waterway Transportation (ANTAQ) requires that national vessels get preference over foreign vessels in Brazilian waters, according to Federal Law 9,432 / 97, as a protection policy for national vessels. The objective of this article is to find the weight of variables in determining the affreightment rate of vessels, considering four groups of factors: vessel, regulation, the market power of Petrobras, and external factors. The results are robust to the OLS to the class of variation of the vessel. Regarding the age of the vessel, market fluctuations and oil price variations, only the Anchor Handling Tug Supply Vessels (AHTS) showed significance with a reduction in charter rate against appreciation of Petrobras' share price. Furthermore, the use of national flag vessels was significant, and this legal requirement increased by 14% the costs in vessels to Petrobras during the period analyzed. This article may be useful for public and private agents operating in the country seeking to explain the remuneration of vessels and the impact of promotion policies to the national flag.

Keywords: Petrobras, maritime support, freight rate, oil, regulation, vessel

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1. INTRODUCTION

Oil extraction is one of the largest and most relevant industries in the world. Because of this, the discovery of new wells in offshore reserves has made some countries, initially unrepresentative, become important world producers. These countries include Norway, Britain, Nigeria, and Brazil. Currently Brazil is listed as one of the largest proven oil reserves in relation to its territorial sea (PETRÓLEO, 2015). The extraction from the oil wells demands very specific shipment models, known as maritime support vessels. Two types of vessels are the most common and are responsible for the greatest costs: the PSV (platform supply vessel) and AHTS (Anchor Handling Tug Supply Vessels) (AAS, HALSKAU, WALLACE , 2009).

Even though it is a recent and evolving market, there is a small amount of work in the maritime support area worldwide, compared to other issues. Notably, in Brazil, no publication was found. In this way, this article seeks to analyze the domestic market in order to provide quantitative data and freight cost for the above-mentioned vessels for the period from 2005 to May 2015. The chosen period was selected due to a certain contractual stability not yet affected by the consistent fall in oil prices occurring since the end of 2014.

To that aim, the chartering contracts of the vessels from the website of the Petrobras company were used. This company accounts for about 90% of Brazilian oil production. This basic database was set up, and its values were adjusted to this work. There was, for instance, an agglutination of contracts dealing with the same scope, as well as, the characteristics of the vessels used.

The objective of the work is to provide a first analysis of costs in function of the models and classes of vessels used in the maritime support, as well as, to analyze a correlation with market variations: oil price and national political stability, in addition to quantitatively assess the regulated impact for the protection of national borders as defined in Brazil by the Law 9.432 / 97.

The results show that the class of the vessel is always an important determinant for the price. The age of the vessel and the price of oil are not statistically significant for the rate of the charter. The stock prices of Petrobras are used as a proxy for the market situation of the company. Significant results were derived from the data. Finally, a national policy of preference for national vessels displays a statistically significant result, with a rise of 13.9% or $1.8 billion in expenses by Petrobras on hiring vessels during the period 2005 to 2015.

This article is divided as follows: First, showing a description of the international market and how Brazil is in this market. Second, it displays the Brazilian market and its peculiarities. Third, it depicts the database, contract work, and statistical analysis. Subsequently, it exposes a discussion of the found results and their consequences for understanding the facts in the market. Finally, it shows the conclusion and suggestion for future studies.

2. *PETROLEUM PRODUCTION IN BRAZIL AND OFFSHORE VESSELS*

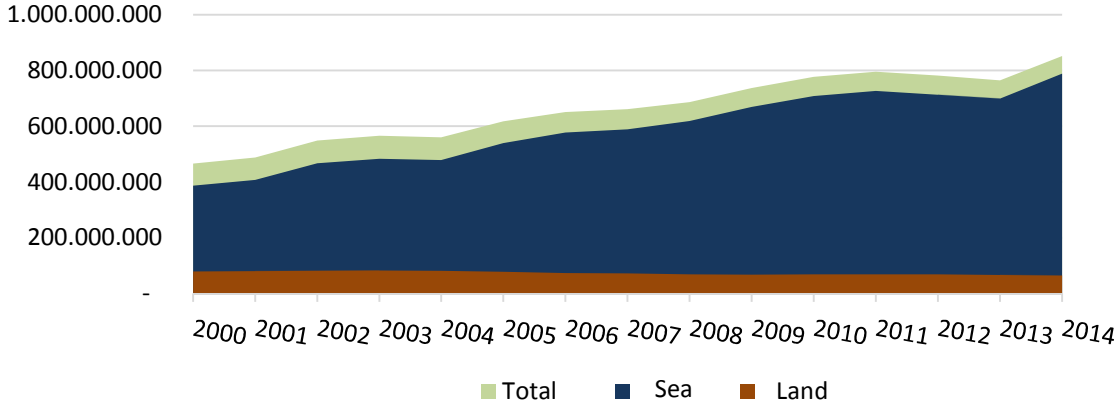
2.1 BRAZILIAN PETROLEUM PRODUCTION

The oil industry is still an important source of energy for the world economy. Despite a bit of a loss for gas and other energy sources in the last 40 years, the oil industry remains the one that holds the most representation. In 1973, oil accounted for 46.2% of the world's primary energy supply. However, in 2013, that figure was 31% (IEA, 2015).

In the world ranking of oil production, Brazil is ranked as the 13th largest producer, representing around 2.5% of the total extraction in the world. In front of Brazil, the world's largest producers are Saudi Arabia with 13% of the world production, Russia, and the United States, with about 12% each, followed by China and Canada, each with 5%, among others with less representation (PETROLEUM, 2015).

The annual Brazilian oil extraction in 2014 was more than 851 million barrels, mainly from exploration at sea. In that year, approximately 93% of the oil was because of offshore exploration (ANP, 2015). According to the chart below, the national oil production from the year 2000 to 2014 has increased, almost all of it, due to the increase in sea exploration since land production had stagnated.

Graph 1 - Oil production in Brazil (barrel / year)



Source: Own elaboration, data from ANP (2015)

Concerning offshore oil production, Norwegian production is entirely from the sea (NorskPetroleum, 2015) while 17% of the North American oil production comes from offshore (EIA, 2015, GOOD, 2010) and Chinese one accounts for about 12% (CNOOC, 2010).

In the Brazilian territorial sea, the largest producer is undoubtedly Petrobras, operating 92% of production. Petrobras is followed by Shell Brasil with 3.1%, Statoil Brasil with 2.8%, Chevron Frade with 1% of the operation in 2014 (ANPb, 2015). This market configuration, due to the relevance of a single agent with a major hold on the production, has its own consequences in market balance as it will be discussed later in this article.

The production of the platforms belonging to Petrobras occurs in the most diverse values of water blade. However, geographically, the most developed area of production is the Bacia de Campos (Campos Basin) in deep waters (PETROBRASb, 2015). Furthermore, by crossing the individual productivity data of Petrobras oil platforms with the depth information of the water (ANP, 2015), it can be seen that the productivity per platform has been increased in waters of greater depth between 1,000 and 2,000 meters of water blade.

Regarding the relevance of offshore production in the world, a market estimation is that at least 30% of the world's oil comes from offshore (shallow and deep waters) (LEHMKÖSTER, 2015). Considering the current level of Brazil's production, this means that the country represents seven percent of the world's offshore market.

In addition, dedicated platforms require the support of several other vessels for marine hydrocarbon exploration, drilling, and extraction activities. These ships, offshore ships, assist in various works, such as transportation production, crew transportation, replacement parts, platform positioning, operation in accidents, among others. Statistics from the Equasis Organization (2011) indicate that there were 6,692 maritime support vessels between active and inactive vessels worldwide. In the same year, there were 427 active vessels in Brazil (ABEAM, 2014), about 6% of the world fleet. Further, according to IHS Petrodata MarineBase (2015), there were 1,809 PSV and 1,951 AHTS in 2014 operating worldwide, of which 103 PSV and 188 AHTS in the national territory (ABEAM, 2014), representing respectively 6% and 10% of the world fleet. These values corroborate the relevance of Brazil in the offshore world scenario.

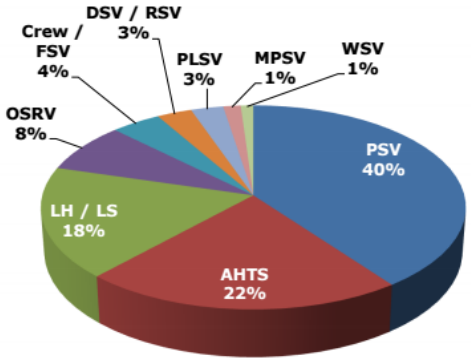
2.2 MARITIME SUPPORT VESSELS - PSV AND AHTS

The vessels that make up this market have a high degree of specialization; however, there is some standardization according to the activity to be carried out. They can be classified according to Rose (2011):

- PSV (platform supply vessels)
- AHT/AHTS (Anchor Handling Tug/Towing Supply Vessel):
- CSV (Crew Supply Vessels);
- FSIV (Fast Support and Intervention Vessels),
- LH (Line Handling);
- MPSV (Multi-Purpose Supply Vessel);
- PLSV (Pipe-laying Support Vessel);
- OSRV (Oil Spill Recovery Vessel);
- UT (Utility Boats);
- Among others

The selected models for the present study were PSV and AHTS. This decision follows other academic works already carried out (BJØRKELUND, 2014; SKOKO et al., 2013 and ROSE, 2009). This decision takes into account the relevance of these vessels in the maritime work considering these are the vessels most frequently used, as shown in Graph 2 below. In addition, the amount paid in freight (charter fees) to these vessels corresponds to the largest share of charter costs of exploration companies (ABEAM, 2014; BJØRKELUND, 2014).

Graph 2 - Distribution of Maritime Support Vessels operating in Brazil by Class.



Fonte: ABEAM, 2014

Thus, these two classes, PSV and AHTS, correspond to 62% of the support operations in Brazil and, for this work, they amounted to 340 charter contracts, for a total amount of USD 13,512,228,261.15.

2.2.1 PSV Vessels

These vessels' job, mainly, is to transport products and supplies to the platforms. They are used in all phases of hydrocarbon prospecting and are required for routine activities, especially at the beginning and end of drilling. They can be classified by their DWT (deadweight tonnage), which measures the water displacement realized by the vessel; it is a proxy of load capacity.

Based on the DWT criterion, the vessels were classified into three classes: small PSV, medium PSV, and large PSV. The average values and their respective deviations were tabulated in Table 1.

Table 1 - Classes, Range DWT, Average Daily Chartering Rate and Standard Deviation of PSV vessels.

Class	Range DWT	Average Daily Chartering Rate	Standard Deviation
PSV	1407 – 5513	US$ 20748.74	US$ 5878.41
Small PSV	1407 - 2500	US$ 17151.05	US$ 3730.63
Medium PSV	2501 - 3500	US$ 19246.45	US$ 4820.17
Large PSV	Over 3501	US$ 25599.37	US$ 5619.17

Source: Own elaboration, based on the contracts of PETROBRAS (2015).

2.2.2 AHTS Vessels

The AHTS are, characteristically, vessels that have winches and cranes to handle anchors and position facilities. Despite having deck space and tanks for liquid cargo, they do not have the same versatility to transport supplies as the PSV. Working capacity is defined by the traction capacity of their cranes measured in HP (horse power).

They have basically three functions: anchor maneuvers on submersible platforms (as their name demonstrates), stocking products, and handling emergencies: combat firefighting (Fi-Fi), oil spill, etc. (SOKOKO, JURCEVIC, BOZIC, 2013). The AHTS are vessels of higher manufacturing cost and use when compared to PSVs and, therefore, the AHTS have a commercial preference for a more stable contractual agreement, with less variation due to the market oscillations. They have more specific periods of use to prospect oil when compared to PSVs.

These vessels show a relatively large variation in some characteristics, mainly with regard to power (BHp), with values varying from 5,200 HP to 28,000 HP. Their range is divided into four classes: small AHTS, medium AHTS, large AHTS, and very large AHTS. Table 2 shows the average values, standard deviation, and a range of HP for each class.

Table 2 - Classes, HP Range, Average Daily Chartering Rate, and Standard Deviation of AHTS vessels.

Class	HP Range	Average Daily Chartering Rate	Standard Deviation
AHTS	5200 - 28000	US$ 34333.04	US$ 22725.44
Small AHTS	5200 - 9999	US$ 15548.56	US$ 7297.85
Medium AHTS	10000 – 14999	US$ 34295.33	US$ 24612.54
Large AHTS	15000 – 19999	US$ 35929.77	US$ 21416.24
Very Large AHTS	over 20000	US$ 47418.57	US$ 23440.96

Source: Own elaboration, based on the contracts of PETROBRAS (2015).

Note that the standard deviation of Average Daily Chartering Rate, in all classes, is relatively high. The influences affecting the value of the charter can be explained by the variation of other factors: the age of the vessel at the time of hiring (zero - 36 years of age), factors related to Petrobras, market regulation, and external factors.

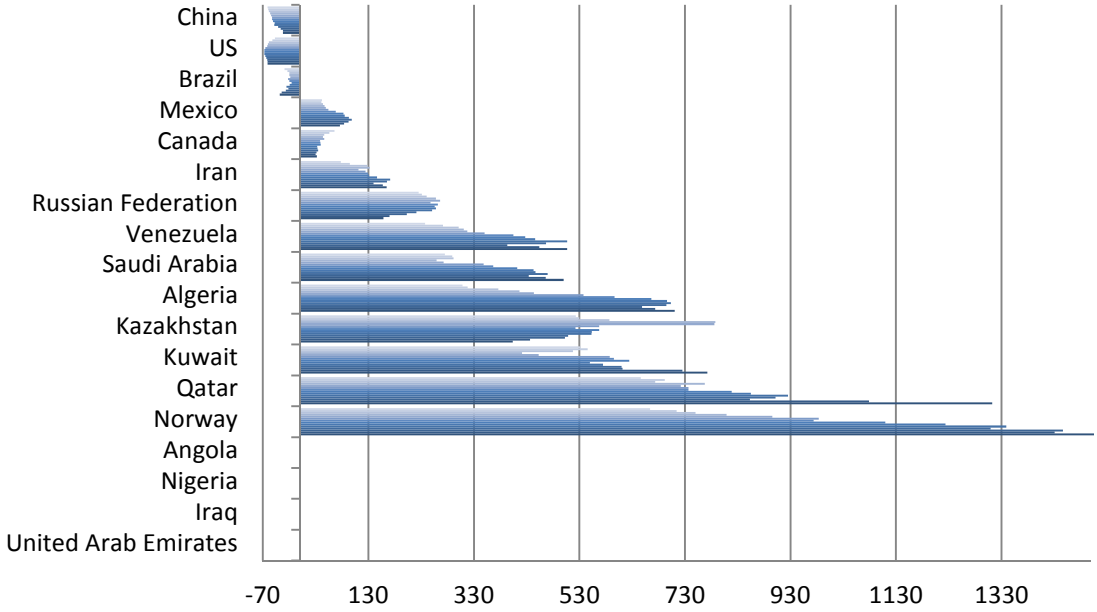
3. PETROBRAS AND THE NATIONAL MARKET

Besides being positioned as a relevant world producer, the Brazilian oil market has some particular characteristics that deserve to be highlighted.

The first one refers to the low relation between oil production and consumption. The production of most of the world's producers is directed to the international market. However, in some countries the domestic demand is so high that it can be absorbed internally, which means, these countries have a deficit of oil production, despite the great production. That results in an interesting market to investment.

This is the case in only three of the major producers: China, USA, and Brazil. Graph 4 was developed using the data from PETROLEUM (2015), showing the surplus or deficit between crude oil production and consumption (excluding oil products) in each country between the years 2000 (dark graduation) to 2013 (clear gradation) in barrels.

Graph 3: Surplus of the Largest Oil Producers 2000-2013



Source: Own elaboration, PETROLEUM data (2015).

Other world producers have different behavior, with a big availability of production for exportation, that means, dependent on international market.

Except in some cases presented, as Angola, Nigeria, Iraq and United Arab Emirates, in Graph 3, which do not have updated consumption figures, a quick comparison of their economies to similar countries makes the figures predictable, so that their internal consumption result can hardly reverse a production surplus.

The second characteristic of the Brazilian exploration is the government control over the production and refining of hydrocarbons. Founded in 1953 as a state-owned company, Petrobras continues to be controlled by the government. Since 1997, with a Petroleum Law (Law 9.478/97), other companies were allowed to carry out oil mining. That stimulated the offshore market; however, this market is still quite centralized, according to ANPb (2015), with about 90% of the national production still being carried out by Petrobras.

The third, is the protection afforded to Brazilian ships, established by the law 9.432/97. It is a normative law that, different from the American Jones Act (The Merchant Marine Act of 1920), applies to the five types of Navigation, including here the maritime support vessels.

As a result of this protectionist law and its regulation by ANTAQ through Normative Resolution number 01/2015, the use of foreign flagged vessels will only be allowed before the verification of the unavailability of Brazilian flag vessels. The main idea of that law is encouraging Brazilian companies acting in support of offshore oil exploration to acquire their own fleet. This verification of the unavailability is done through a fully digitized system - SAMA (Maritime Navigation Chartering System). The negative answer or their omission is understood as the unavailability of a Brazilian vessel to perform a certain task, this way, with the issuance of the charter authorization for a foreign vessel.

Other legal incentives are also present, such as REB - Law 9.432 / 97 and Decree 2.256 / 97 - a form of second registration of the flag of the vessel, and PROREFAM - Program of Renewal of the Maritime Support Fleet, which was launched in 2000.

This market configuration creates an oligopsony in which Petrobras acts as the main demander of maritime support vessels. Petrobras is hiring these vessels through a market very close to the perfect competition on the side of the suppliers, due to the large number of agents with vessels from various parts of the world, which consequently drives the prices down. In other kinds of markets, closer to their maximum use of vessels' time, the supply of vessels becomes highly inelastic (BJØRKELUND, 2014).

The national flag defense, in this case, increases complexity once the companies begin to take advantage and develop national vessels to meet the demands. There will be, in that way, a restriction of supply of vessels (if compared with world supply) that will cause a difference in the final price in the chartering rate. This impact is the subject of this article.

It is interesting to note that the presence of an internal demand for oil in Brazil's market creates an attractive situation of long term for shipping companies since a long contract market is more interesting than a spot one. The drop-in world oil prices that began at the end of 2014, with a reduction in world demand, has become another variable in favor of market power over the companies that operate the vessels.

4. DATABASE AND MODEL

This section shows how the database was assembled, the criteria used in the analysis, and the modeling that serves as the basis for the regressions. In the first part, the source and how the analysis of the daily rate of the vessels was constituted is shown. In a second part, the modeling of the factors that determine the daily rate of the contracted vessels is shown.

4.1 Source of Data and Adjustments Require

The source of the data in its raw form was obtained through the website portal "Access to Information" of Petrobras. On this site, all the contracts established by the company in the hiring of vessels were searched, totaling in that first review, 1408 contracts signed between 2005 and 2015.

Each one of those contracts provides dates of beginning and end, the value in Dollar (USD) or Real (R$), the name of the company, as well as the name and class of the vessel. Through the vessel's name, it was possible to obtain from specialized websites other characteristics related to the vessel (power, length, and year of construction).

The next step was to cross reference the information and remove all contracts with vessels not subject to analysis of this article such as rig contracts and maritime support vessels of different classes (ORSV, LH, Crew, etc.). Finally, it was determined that there were 746 contracts with the vessels PSV and AHTS.

After this, some corrections were necessary. Some contracts are made for the same vessel and with the same date of the contract. This happens because charters receive some values in Dollar (USD) and some in Reals (R$). This fact is due to the

different types of costs faced by companies with national and international inputs. For example, let's take a look at the PSV C-Vendaval shipping agreement.

TABELA 3 – Charter contract PSV C-Vendaval

Contract	Start Date	End Date	Value in Reals (R$)	Value in Dollar (US$)
1	26/04/2013	27/09/2013	2,443,213.85	
2	26/04/2013	27/09/2013		511,500.00

Source: Own elaboration, based on the contracts of PETROBRAS (2015)

The currency conversion, whenever necessary, was made at the exchange rate prevailing on the day of signature of the agreement. Recalling, as we are dealing with a period of 10 years of contracts, all contracts were updated in time by the Consumer Price Index; therefore, taking into account an index of inflation of the United States.

TABLE 4 - PSV Up-Topaz Vessel Agreement

Contract	Start Date	End Date	Value in Reals (R$)	Value in Dolar (US$)
1	03/06/2013	01/06/2017	9,103,423	13,451,347
2	07/04/2014	01/06/2017	17,113,780	25,287,563

Source: Own elaboration, based on the contracts of PETROBRAS (2015).

In the second contract example, Table 4, for the Up-Topaz vessel, the contract dates were not fully coincident. This can be justified by an assignment of the legal obligations of the foreign vessels when are in short periods in Brazilian jurisdictional waters. After this period the vessel has to be completely in accordance, in such a way that it is the moment when the second contract begins. As in the previous example, the values were converted into US dollars and adjusted, with the values of the no coincident period of the contracts being disregarded in order not to distort the effective daily market rate by dedicated vessels for long periods. Note that both were finalized on the same day.

After that, with the contracts all in dollars and adjusted by the inflation in the period, the sum of the contracts for the same vessel value was divided by the number of days contracted, thus obtaining the Adjusted Daily Rate, the basic unit used by the market and also in this study.

At the end of this process 434 contracts were left, excluding those with null values or below the market average (below $ 11,000 per day), resulting in 205 PSV and 135 AHTS vessel contracts.

4.2 Formation of Chartering Charge

It was assumed that the daily value of vessel charter (Td) is basically composed of four factors: Vessel characteristics (Ce), such as size, age, power, carrying capacity; Requirements of the Demandant (IFp), in this case, Petrobras; Regulation (Re), norms and laws of this market; And finally, the influences of the external market (IFex). The Td is the adjusted daily rate.

The relationship between the four factors can be represented as follows:

$$Td = Ce + IFp + Re + IFex$$

In the variable, vessel characteristics (Ce) were taken as a criterion of the type and the class to which the vessel belonged. Other characteristics, except for age, were not included in the regression, once they present a multicollinearity problem.

Regarding the demanding influences (IFP), they were utilized as a proxy for the price of the preferred stocks of Petrobras. Although not an accurate indicator of the company's financial position, stock exchange tends to absorb expectations of increasing or decreasing gains relative to the company's future.

In order to measure the influence of the regulation (Re), a dummy is included. It absorbs the effect of the main rule in the market, the policy of preference of the national vessels specified in Law 9.432 / 97.

Finally, to measure external influences (IFex), the oil barrel price is used as a proxy to evaluate the changes in the international oil market over the Brazilian's market of offshore vessels.

5. RESULTS

5.1 OLS results for PSV vessels

The results for PSV vessels are shown in Table 5. In column [1], it was estimated only using the vessels' classes, for this the Medium PSV class was ignored to serve as a reference. The results were similar in all estimates, always with statistical significance at 1%.

The Small PSV class displays a reduction of US $2095.39 to US $3115.28 in their freight rate if compared with the Medium PSV. Considering that the average rate is US $20748.74, the reduction ranges from 10% to 16% in the daily rate. Estimates indicate that a vessel defined as Large PSV class presents an increase in the rate from US $5123.53 to US $6352.91 when compared with the Medium PSV.

Table 5 - Results of the PSV's OLS

	[1]	[2]	[3]	[4]	[5]
Small PSV	-2095.39** (904.19)	-2324.87* (841.49)	-3115.28* (813.94)	-3114.76* (5244.94)	-2737.63* (858.37)
Large PSV	6352.91* (787.42)	5358.94* (752.31)	5378.50* (713.09)	5244.94* (721.08)	5123.53* (725.23)
Brazilian Flag	___	3998.66* (698.69)	4151.39* (662.99)	4146.30* (662.30)	4399.40* (687.14)
Petr4 lagged 1 year ago	___	___	305.81* (62.78)	290.75* (63.97)	299.32* (64.15)
Oil Price (>US$70)	___	___	___	952.90 (798.74)	795.36 (805.65)
New vessel (>1993)	___	___	___	___	1671.30 (1240.85)
R^2	0.3149	0.4100	0.4734	0.4771	0.4818

Note: total number of 205 observations. * Significant at 1%, ** significant at 5%, *** significant at 10%.
Source: Own elaboration (2016).

In column [2], a dummy was added, if the vessel was registered as Brazilian or not. This dummy obtained all results as statistical significance in a confidence interval of 1%. The results ranged from US $3998.66 to US $4399.40 of appreciation in the daily rate if the vessels were Brazilian.

Regarding the influence of Petrobras shares, measured from column [3], the results were not significant for the stock price on the day of the contract, but for the price lag one year prior. Different from the estimates for the AHTS model, in which a stock valuation positively influences the result (see below). This could be associated with increased vessel utilization at more specific periods of extraction at the beginning and at the end of the survey, typical of PSV.

Finally, the price of oil - in column [4] and [5] - and Age of vessel - column [5] - did not obtain significant results.

5.2 OLS Results for Vessels AHTS

In column [1] of Table 6, only the classes of the vessels were included as variables. In the first estimate, the small and large classes presented significant results. The Medium AHTS class was ignored for use as a reference.

In the other estimates, the values presented statistical significance, and the Small AHTS class presented a reduction slightly above US $7,100.00 in the charter rate in relation to the Medium AHTS. The Large AHTS class has a valuation above $6,211.76, and finally, the Very Large AHTS class an addition of (around) $18,000.00 in the charter fee when compared with Medium AHTS. The average rate is US $34,333.04.

Table 6 - Results of estimates of AHTS Vessels by OLS

	[1]	[2]	[3]	[4]	[5]
Small AHTS	-18836.77* (6132)	-7104.69*** (4360.31)	-7848.76*** (4596.38)	-7417.74*** (4410.67)	-7175.89 (4439.87)
Large AHTS	1632.44 (4711.62)	6823.63** (3299.38)	6140.46*** (3545.88)	6195.71*** (3401.33)	6211.76*** (3409.92)
Very Large AHTS	13123.24** (6045.59)	18779.78* (4223.23)	18049.59* (4448.94)	18293* (4268.1)	18569.05* (4303.11)
Brazilian flag	___	42528.79* (3570.37)	41725.56* (3881.68)	39810.09* (3763.56)	39917.65* (3777.18)
New Vessel (>2000)	___	___	1629.28 (3042.34)	-1367.67 (3041.79)	-1723.22 (3105.96)
Stock Price Petr4	___	___	___	-868.69* (248.69)	-796.07** (276.92)
Oil Price (>US$70)	___	___	___	___	2273.82 (3773.91)
R^2	0.1573	0.5971	0.5980	0.6330	0.6340

Note: total number of 135 observations. * Significant at 1%, ** significant at 5%, *** significant at 10%.
Source: Own elaboration (2016).

The dummy for national vessels was included from column [2]. In all estimates, the variable presented a significance of 1% and values ranging from US $39,810 to US $42,528.

In column [3] and subsequent, a dummy was included for vessels built after the year 2000. However, in none of the estimates did the result show significance. Other attempts using age as a discrete variable also did not show statistically significant results, which leads one to believe, therefore, that the age of the vessel is not a significantly important criterion in the definition of the charter rate or that its influence can be eliminated by prior screening test before signing the contract.

In columns [4] and [5], the price of Petrobras preferred shares is used as a proxy for the influence of demand. The parameter presented a statistically significant value, indicating a reduction between US $868.00 and US $796.00, respectively, for a

valuation of a Real (R$) in the stock. Thus, a valuation of Petrobras' prices leads to a decrease in the charter rate for vessels of the AHTS type.

Other analyses were made using the stock price lag at 3 months, 6 months and 1 year, but they did not present statistically significant results. This phenomenon can be explained by an increase in the market power of Petrobras in the face of an improvement in the Brazilian market's expectation. In addition, once the contracts with this type of vessel tend to be for longer periods and with larger values, consequently they were better observed by the OLS.

Finally, in column [5], the international oil price was added - Oil Price - to measure the relation of the international market with the value of the charter. This result indicates that there is no direct relation among the variables. Although the offshore vessel market is international, the results indicate that the affreightment rate is more defined by factors of the vessel itself and of Petrobras than for international oscillations of oil price, during the period analyzed.

5.3 Impact of Law 9.432 / 97: Policy of National Vessel

Once the impact on the daily charter rate is estimated, it is possible to calculate the total budgetary impact on Petrobras' accounts over the period from 2005 to 2015. Table 7 indicates the class, number of contracts with national vessels, total contracted days, and the estimated impact through the OLS regressions. For this calculation, the most complete estimations were used (greater number of variables, column [5]).

Table 7 - Financial impact of flag protection

CLASS	Number of contracts with Brazilian Flag Vessels	Total days contracted	Estimated impact on daily rate	Total impact
PSV	65	97,376	US$4399.40	US$ 428,395,974.40
AHTS	21	35,902	US$39,917.65	US$ 1,433,123,470.30
Total	86	133,278	__	US$ 1,861,519,444.70

Source: Own elaboration (2016).

Then, over the course of about 10 years - 2005 to 2015 - the cost to Petrobras of hiring Brazilian vessels, in compliance with Law 9,432 / 97, increased US $1,861,519,444.70 to its cost with the charter. As a comparison, the sum of all Petrobras contracts totaled US $13.3 billion, that is, the impact of the policy when compared to the total represented around 13.9% of the total contracted.

When taken as separate markets, the PSV charter market amounted to $ 6.32 billion, the impact of the national flag policy represented 6% of the amount. In turn, for the AHTS, which the total impact was measured at $1.433 billion, the flag protection reached $6.76 billion national, so that protection policy accounted for 21.3% of the total.

CONCLUSION

In this article, the main components of pricing of PSV and AHTS vessels through contracts signed with Petrobras, the leading operator of oil extraction in Brazil, were analyzed. Due to the absence of previous studies, the present study used the database starting from the year 2005 to May 2015 in order to analyze the contracts under price conditions for about ten years and to identify its initial reaction to the fall of oil prices in the international market.

The average contracting values for PSV and AHTS vessels operating in Brazil were presented. These estimates are US $20,748.74 and US $34,333.04, respectively. It has been shown that for each class variation, the vessel undergoes a change in its daily charter rate, all with statistical significance.

Regarding the other variables analyzed - vessel age, market variations, and oil price changes in the period - none has significant statistical relevance, but the AHTS charters presented significant response when faced up against the price of the Petrobras share. Reduction in the daily rate of around US $800.00 for each R$1 of Petrobras' shares appreciation was found. That could be interpreted as an increase in market power of Petrobras when in negotiation of the freight price in periods of expectations of market improvement.

In addition, the impact on the daily charter rate resulting from the preference for the use of national flag vessels, as stated in Law 9.432 / 97, was evaluated. The cost of the daily rate of Brazilian vessels was approximately US $4,399.00 for PSV and US $40,000 for AHTS. Taking into account the employment of these vessels in the aggregate of contracts during the period of the survey, this requirement increased by 13.9% the cost of vessels contracted during the period.

This article can be useful for companies operating in the country, in order to measure - in a window of ten years - the remuneration of the vessels and, thus, help them to balance their decision of feasibility of purchase or construction of new vessels. Likewise, the government, policy makers, and regulatory agencies can understand quantitatively the variables that affect the market and to direct public policies in favor of fair competition. In particular, everyone can be aware of the market power of Petrobras and the impact of policies to stimulate the national flag.

It could be suggested for future studies to see if the market accommodation of the new oil price, which is still happening at the time this article is written, is related to the collapse of the world’s oil prices and the investigations of administrative interference in Petrobras.

References

ABEAM, Frota de Embarcações de Apoio Marítimo em Operação no Brasil - Dezembro / 2014. Disponível On-line: http://www.abeam.org.br/upload/frota-de-apoio-maritimo-dez-2014.pdf . Acessado em 16/01/2016.

ANP, Dados D&P, Disponível On-line: http://www.anp.gov.br/?id=368. Acessado em 16/12/2015.

ANPb, Boletim da Produção de Petróleo e Gás Natural Janeiro 2015, mar. de 2015.

BJØRKELUND, Atle Magnus. **Pricing in Offshore Shipping Markets**. 2014. Tese de Doutorado. Norwegian School of Economics

AAS, Bjørnar; HALSKAU SR, Øyvind; WALLACE, Stein W. The role of supply vessels in offshore logistics. **Maritime Economics & Logistics**, v. 11, n. 3, p. 302-325, 2009.

CNOOC. China's offshore CNOOC started to peak in 2010. Maio de 2015. Disponível on-line: http://crudeoilpeak.info/chinas-offshore-cnooc-started-to-peak-in-2010. Acessado em: 20/03/2016.

IHS Petrodata MarineBase DATA QUALITY GOALS. 2015

IEA – International Energy Agency. Key World Energy Statistics, 2015.

KAY, Stanford. Transparency: How Much Oil Do We Get From Offshore Drilling? Maio, 2010. Disponível on-line em https://www.good.is/infographics/transparency-how-much-oil-do-we-get-from-offshore-drilling. Acessado em: 25/03/2016.

LEHMKÖSTER, Jan. World Ocean Review, Capítulo 1. Oil and gas from the sea. 2015. Disponível on-line em: http://worldoceanreview.com/wp-content/downloads/wor3/WOR3_chapter_1.pdf . Acessado em: 20/02/2016.

MODEC. About Offshore Oil & Gas Industry. Disponível online: http://www.modec.com/about/industry/oil_gas.html. Acessado em 15/03/2016.

NORSK PETROLEUM. Everything you need to know about Norwegian petroleum activities. 2016. Disponível online: http://www.norskpetroleum.no/en/utskrift#toc-3-article-2. Acessado em 15/03/2016.

OLIVEIRA, Patrícia V.; ALMEIDA, Edmar F.. Impactos Recentes da Politica de Controle Indireto dos Preços de Gasolina, Diesel e GLP na Petrobras. Rio Oil & Gas 2014 – Expo and Conference. IBP1871_14

PETROBRAS. Licitações e Contratos assinados. Rio de Janeiro. 2015. Disponível em < http://sites.petrobras.com.br/minisite/acessoainformacao/licitacoes-e-contratos/>

PETROBRASb. Formulário 20-F. Relatório Anual de acordo com o Artigo 13 ou 15(D) da Lei de Valores Mobiliários de 1934, Washington D.C. Estados Unidos da América. 15 de mai de 2015

PETROLEUM, British. Statistical review of world energy 2015. **BP, London**, 2015.

ROSE, Robin Sebastian Koske. Future Characteristics of Offshore Support Vessels. Submitted to the School of Engineering in partial fulfillment of the requirements for the degree of Master of Science in Computation for Design and Optimization at the Massachusetts Institute of Technology, February 2011.

SKOKO, Ivica; JURČEVIĆ, Marinko; BOŽIĆ, Diana. Logistics Aspect of Offshore Support Vessels on the West Africa Market. Promet – Traffic&Transportation, Vol. 25, No. 6, p. 587-593. 2013.