

INDUSTRIAL CONCENTRATION ANALYSIS IN BIODIESEL PURCHASE AUCTIONS PROMOTED BY ANP

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Abstract

The objective of this article is to analyze the industrial concentration evolution of the participant companies of biodiesel purchase auctions promoted by the Petroleum, Natural Gas and Biofuels National Agency (ANP). The analyses were accomplished starting from the identification of the participation of each company in auctions, the industrial concentration indices calculation of each auction and the evolution comparison of industrial concentration in relation to National Program of Production and Use of Biodiesel (PNPB) objectives. The identification of these factors is very important to understand the program operation after almost five years of its creation. The need to search for new renewable energy sources has been taking the countries to look alternative raw materials, in this point Brazil is privileged to have a great number of possible alternatives to produce in all the country's areas, respecting the economic, soil and climatic characteristics. The addition of biodiesel to diesel has been motivating several oilseeds varieties cultivation and to promote the income creation and social inclusion, giving emphasis to familiar agriculture. Since program implantation, the addition percentage to diesel has increased, even before the Law 11.097/05 established. The obligatory percentage now is 4% and it started in July 2009, and in 2013 it will arise on 5%. The increase number of participant companies in auctions indicates that this commercialization mechanism has been braced and reached its objectives to create biodiesel market and to promote the great number of companies' participation. The concentration indicators' analysis evidenced a market in franc decrease concentration process and inequality in market portions distribution.

KEYWORDS: industrial concentration, PNPB, biodiesel auctions

1. Introduction

The objective of this article is to analyze the industrial concentration evolution of the participant companies in biodiesel purchase auctions promoted by the Petroleum, Natural Gas and Biofuels National Agency (ANP). The analysis will be made by the participation identification of each company in the auctions, the industrial concentration indices calculation of each auction and the evolution comparison of the industrial concentration in relation to the objectives of the National Program of Production and Use of Biodiesel (PNPB). The identification of these factors is very important for program operation understanding after almost five years of its creation.

The Law 11.097/05 determines the volume to be produced and the increase of diesel addition to diesel. Even the increase of 1% in the volume demanded can affect market operation negatively, offering not production adjustment time for the biodiesel producer companies. A point deserves to be show up is that even after the biodiesel price is determined in auction, the raw material cannot have been price fixed, resulting in a high production cost and a low return for the companies, discouraging the participation in the auctions.

The auctions as structure of market regulation is result of a fast adjustment need of offer and product demand. Besides, to understand the evolution of participant companies concentration in auctions helps to place the adherence movement of companies to this new program. Besides understanding the participant companies concentration in the auctions evolution, it helps to indicate companies adherence movement to this new program, in relation to the trust and reputation.

The theoretical framework presentation seek to move forward in exploration of the context which the research is inserted, presenting and addressing the used concepts, such as PNPB, the biodiesel auctions and the concentration measures. For the research accomplishment secondary data were used, collected through electronic and bibliographical way, using scientific papers, books related to research' theme and bulletins of information popularization referring to auctions.

To the analysis and discussion was used partial measures concentration represented by concentration reasons CR(4) and CR(8), and summary measures represented for Hirschman-Herfindahl (HHI). This research follows the reasoning of Resende and Boff (2002) which considers the usefulness of concentration measures in indicating the sectors which is waited significant market power.

In function of PNPB objectives and the current conditions of raw materials production, processing and biodiesel distribution, appears the need to analyze the companies participation in the mechanism of biodiesel commercialization instituted by Federal Government and accomplished through ANP: the auctions. Thus, the research question which orientates this study's accomplishment is “which are the decisive factors of evolution in industrial concentration in ANP auctions?”

1.1 Objectives

1.1.1 General objective

To analyze the industrial concentration evolution in industries participation in the biodiesel purchase auctions promoted by ANP.

1.1.2 Specific objectives

- To identify each company participation in the auctions;
- To calculate industrial concentration indices in each auction; and,
- To discuss the evolution of industrial concentration by the PNPB objectives.

2. Literature Review

2.1 National Program of Production and Use of Biodiesel (PNPB)

In December of 2004, Federal Government inaugurated the National Program of Production and Use of Biodiesel (PNPB). The objective is to implant technique as economically maintainable way the biodiesel production and use focusing in the social inclusion and in regional development, by employment and income creation. The program guidelines are set in the implantation of a social program, promoting the social inclusion, competitive prices warranty, quality and supply, and biodiesel production from different oilseeds sources and in several areas.

The program regulatory mark was the Law 11.097/05 that established the biodiesel addition to diesel minimum percentage and its monitoring. In July 2008, the 2% optional percentage became 3% obligatory, in July 2009 it became 4% and in 2013 it will be 5%.

The program is in its first steps, so, it is possible that still flaws and guidelines are not the reality waited. Soybean is in the place of familiar agriculture cultures that should be pulling the program. This order participant agents possess determined degree of interests, and conflicts are in the production agricultural and regional ambit. The castor oil biodiesel production incentives are conflicting to crushing soybean big producer organization (PAULILLO et al, 2007).

Thus, it is noticed biodiesel market (together to alcohol market) has growing in the last years due to organized groups and federal governments to environment and dependence reduction of imported petroleum (PAULILLO et al, 2007).

The biodiesel tributary rules refer to PIS/PASEP and COFINS determine that those tributes are collected at only one time and the taxpayer is the biodiesel producer. The biodiesel producer can opt among aliquot percentage that happens on the product price, or for the specific aliquot payment, that is a fixed value for cubic meter of commercialized biodiesel, as it disposes the Law 11.116, of May 18, 2005. These tributary rules vary in agreement to biodiesel raw material origin, it can be from castor oil or palm coming from North, Northeast or Semi-arid familiar agriculture areas; any raw material produced by independent familiar agriculture area; biodiesel produced from the castor oil or palm in the North, Northeast or Semi-arid for the agribusiness areas. In the first case there is 100% reduction in relation to the general aliquot of R\$ 217,96, in the second case there is 67,9% reduction and in the last case it is of 30,5% (PORTAL DO BIODIESEL, 2009).

The biodiesel production and use in Brazil propitiate the maintainable energy source under the environmental development, economic and social aspects and they also bring the reduction perspective of the diesel imports. In 2008, biodiesel use avoided 1,1 billion liters of diesel of petroleum import, resulting in US\$ 976 million savings, creating exchange value to the Country (ANP, 2009).

ANP affirms the Brazilian main oilseeds production totalled 60,6 million tons in the 2006/07, 95% referring to soybean. The remaining portion is cotton pit, peanut, castor oil and sunflower (CONAB, 2007 *apud* ANP, 2009). As for palm, production was 903,5 thousand tons in 2005 (IBGE, 2005 *apud* ANP, 2009) and, it is considered this same volume in 2007, 1,5% of oilseeds total participation.

Brazil has several options for vegetable oils production. So, there are several alternatives to structure the program of production and use of biodiesel. The challenge is to take maximum advantage to the regional potentialities and to obtain the largest biodiesel production social benefit, applying the technology as to traditional cultures - soybean, peanut, sunflower, castor oil and palm, as (*Jatropha curcas L.*), (*Rafhanus sativus L.*), pequi oil (*Caryocar brasiliense C.*), (*Maurita flexuosa L.*), macaúba (*Acrocomia aculeata J.*) and great variety of oilseeds to be explored (BRASIL, 2006).

Stand out that, although the list of sources of vegetable oils to PNPB is wide, in the practice, seven of them have a significant production. The others of them, although have potential, in fact they are used in the popular medicine and in cosmetics industry, being constituted in market niches to high final prices. Most of the extractive oilseeds don't have still technical and marketing studies for commercial exploration. In agreement to ANP data, in May of 2009 soybean was responsible for 81,33% of the biodiesel produced at the country, thus, most of the companies receives an reduction accordance the second case mentioned above (ANP, 2009).

In each state and region of the Country different vegetable oils productive chains is being evaluated, for the Agriculture Ministry. Thus, biodiesel production should respect each area producing specificity, in a certain way, it will provide a larger competitive advantage (MELLO, PAULILLO; VIAN, 2007).

Brazil is the second main vegetable oil exporter in world and it provisions the demand of the world's most populous countries as China and India, by virtue of economic growth, they demand a larger volume to human consumption oil and to energy production. Therefore, the warranty of vegetable oil provisioning in Brazil to Biodiesel production will depend on the product dynamics in the international and national markets. Besides, Brazil presents inequalities in regional agricultural development, presenting the use of high technology in oilseeds production in Cerrado area, low technology use in Caatinga area and the restriction in palm in Amazon area, once doesn't exists consent about use of an exotic plant for economic exploration in the largest world forest. So, the crushing capacity and provisioning of vegetable oil to biodiesel production should be evaluated regionally, in function of diesel regional consumption (OSAKI; BATALHA, 2008).

To guarantee the necessary biodiesel supply, several subjects still have to be solved, among which it can stand out: a) the plants approval whose solicitation processes in ANP and the effect materialization of proposed projects, guaranteeing the necessary installed capacity to assist the consumption; b) the heavy investments accomplishment in research and more capable agricultural varieties to biodiesel production development; c) investments in technologies process that promote the oilseeds species energy thickening, increasing the productivity and avoiding the pressure for incorporation of new agricultural areas; d) the incentives to commercialization of generated sub-products, seeking to production cost reduce; e) the fiscal exemptions concession in all producing areas, motivating the production in wide scale; and f) to give biodiesel market effective warranty to assured by the legislation already approved, which includes the product displacement heavy cost of remote areas for mixture centers (MELLO, PAULILLO; VIAN, 2007).

The Table 01 presents the data about the evolution of biodiesel production since the PNPB beginning. It is possible to notice that the production grew in intense rhythm starting from June of 2008, when the obligatory addition of biodiesel to the diesel became of 3%.

Table 01: Biodiesel Production Evolution

Biodiesel production¹ - B100² - 2005-2009 (m³)

Month	YEAR				
	2005	2006	2007	2008	2009
January	-	1.075	17.109	76.784	89.516
February	-	1.043	16.933	77.085	80.274
March	8	1.725	22.637	63.680	131.330
April	13	1.786	18.773	64.350	105.717
May	26	2.578	26.005	75.999	103.666
June	23	6.490	27.158	102.767	
July	7	3.331	26.718	107.786	
August	57	5.102	43.959	109.534	
September	2	6.735	46.013	132.258	
October	34	8.581	53.609	126.817	
November	281	16.025	56.401	118.014	
December	285	14.531	49.016	112.053	
Total year	736	69.002	404.329	1.167.128	510.503

Source: ANP/SRP, according to ANP Portaria.º 54/01.

Notas: (m³) = cubic meter.

(n/d) = not available.

¹Pure biodiesel or B100, according to ANP Resolução nº 42/2004.

² Authorized producer plants by ANP.

³Percentage sum variation of the values from January until determined month of the year 2009, in relation to the sum of the same period of 2008.

Source: ANP, 2009.

To Barros, Alves and Osaki (2008) the economic viability of biodiesel production in Brazil depends on vegetable oil export prices in the same way that the sugar cane ethanol profitability depends on the gasoline price.

According to Prates, Pierobon and Costa (2007), biodiesel price will depend directly on the main raw material cost, the vegetable oil or the animal grease, that can be obtained in five ways: 1) oil bought done, raw or degummed of the milling industries; 2) grains oil by own production; 3) used oil bought of companies that use vegetable oil in fries and; 5) oil derived of animal suet, mixed to vegetable oils.

2.2 Biodiesel auctions

The auction is not a pure market. It is a system starting from the auctioneer mediation function, and the games rules established for its participants (MACHADO FILHO, 2000). Same author said that, starting from larger product standardization, the governance institution through auctions could prevail in a larger interval, even in the specificity of commercialized assets. In spite of the countless barriers to an electronic system larger growth, all the evidences point this should be the new concept of auctions, in a not very distant future.

ANP accomplishes, since 2005, the biodiesel auctions. In these auctions, refineries and dealers buy the biodiesel to mix to petroleum derived diesel. The auctions initial objective was to create market and, to stimulate biodiesel production in enough volume to refine and distributors could compose the mixture (BX) determined by law (ANP, 2009). The participants are: the auctioneer (indicated by ANP); the buyer (refineries and dealers); offers (biodiesel producer companies).

The auctions continue being accomplished to assure that all diesel oil commercialized at the country contains the percentage of biodiesel determined in law. The biodiesel production and use in Brazil propitiate the development of a maintainable energy source under the environmental, economic and social aspects and they also bring the perspective of the diesel oil imports reduction (ANP, 2009).

A maximum price is specified to be payed for the buyer starting from then the throws are offered so that each throw it covers the other for the smallest price collected by m³. In agreement with the ANP calculation of references maximum price it takes in consideration mainly the raw materials market quotations added production and tributes medium costs.

Szuster (2008) describes the first 11 auctions operation accomplished. The model chosen by ANP for the first four auctions was First Stamped Price, without price change possibilities after the only throw. In other words, the proposals were sent for a electronic way, that just crier had access to this and, later on, the result was released to participants, without these could incur in any type of initial offer alteration. The auctions became divided in two stages. In first stage, it was similar to the first four mechanism, the throws were stamped and sent for electronic way to auctioneer. In the second stage, "competitive" phase, a new phase began in that participants could reduce its throws in agreement with the information disclosed by the auctioneer. The auctioneer informed all the participants which was the smallest value throw to the moment (real time updated). It means to say that participants knew the auction smallest value throw in every moment, they could reduce it, if it was them interest. From 8th until the 11st auction, ANP altered the rules in the sense of maintaining certain competitiveness degree, however, to allow the increase number of participants again. This way, in spite of some innovations, the regulator agency opted for a mixed model, which already mixed characteristics of first two groups presented. A considerable change in relation to all the other previous auctions was to the accomplishment of presence auction form, differently of the previous ones, accomplished for an electronic way.

When the throws are offered on-line, the ANP public auctions are not presence, there are the advantages of smaller transaction cost (information, negotiation and monitoring costs), smaller transport cost, participation of larger number of biodiesel producer employees' possibility, speed and agility, etc. The disadvantages can be considered as being the non knowledge of the throw offered for the competitor. A particularity considered is that in the auction moment doesn't happen the product quality verification. The verification happened on the delivery, in other words, when buyer will remove the product in the throw winning company, in the sale case Free on Board (FOB).

In agreement to Agrarian Development Ministry (MDA, 2006) the pré-requirement to participation in auctions is the "Social Combustible Stamp". This is an identification component granted by MDA to biodiesel producers that promote the social inclusion and the regional development, it means, employment and income cretion for framed family farmers framed in criteria of Familiar Agriculture Attendance National Program (Pronaf).

This stamp allows to biodiesel producer access to aliquots of PIS/Pasep and Cofins with differentiated reduction coefficients, access the best conditions of financings at Economic and Social Development National Bank (BNDES) and its accredited financial institutions, Amazon S/A Bank (BASA), Northeast of Brazil Bank (BNB), Brazil Bank S/A or other financial institutions that possess special financing conditions for Social Combustible Stamp projects. The Stamp can also be used for marketing promotion of holder companies.

The Stamp is only granted to biodiesel producer that: 1) buy family agriculture raw material at least percentage of 50% in Northeast and Semi-arid area, at least 10% in North area and Center-

West area and at least 30% of the Southeast and South area; 2) make negotiated contracts with the familiar farmers consisting at least the contractual period, the value of the purchase and contracted price readjustments, the conditions criteria, raw material delivery conditions, each part safeguard and the identification and agreement of farmers representation that participated in the negotiations; 3) assure attendance and technical training to familiar farmers.

Until the last MDA update available in April 2009 there was 30 holder companies of Social Fuel Stamp, renewed each 5 years. Until August 2009 14 auctions were accomplished, that totalled offered volume of 4.875.191 m³ and finished volume of 3.030.000 m³ (ANP, 2009).

This coordination mechanism has been presenting markets problems fetures of asymmetric information. Buyer and biodiesel producer contract possess different information about the transaction. It results in economic efficiency deviation in the biodiesel market. The market faults in the biodiesel auctions contracts result from asymmetric information, as the adverse selection and the moral risk. Biodiesel supply contracts to Petrobras have been presenting market faults. These market flaws can be observed through the difference between the negotiated volume and the produced volume (OLIVEIRA; RODRIGUES, 2008).

After participate in auction and won the throw, a contract is elaborated between biodiesel producer and buyer, containing volume data, local, product quality to be given, delivery way, price, etc. If the property rights are not defined or guaranteed, and if there are external shocks destabilizing, and if the economic agents' behavior is not benign and cooperative, operation costs emerge of the markets, justifying the appearance of the contracts (ZYLBERSZTAJN, 2005).

2.3 Industrial concentration

Industrial concentration central interest, by economic view, turns possible the monopoly power exercise, or more generally, of the market power, in no perfect competition structure (BRAGA; MASCOLO, 1982). Therefore the market structure plays a decisive part inside of the paradigm structure-conduct-performance (ECD).

Azevedo (1998) explains that the paradigm ECD has the main concern certain market acting evaluation front the acting waited in a perfect competition ideal situation. In other terms his explanation indicates that tries to evaluate in what measured the market imperfections mechanism limit the capacity in assisting the aspirations and demands of society for goods and services.

It is confront between the economic acting of an imperfect structure and the acting in competitive ideal. The economic acting, accept as a dependent variable, can be altered accorded to market structure interventions and the firms conduct (AZEVEDO, 1998).

Braga and Mascolo (1982) affirm that in market structures near monopoly prices usually exceed the long term medium costs, not evidencing a space taken improvement advantage collective well-being, accorded to economy resources reallocation. The authors aim that allocative inefficiency that accompanies the market power, is in origin of monopoly doctrinaire condemnation - and, for extension, at the industrial high levels concentration - and to ideal exaltation of perfect competition.

For Bain (1958) production concentration and sales level consists in the main structural factor capable to affect the coordination degree of established companies conducts, turning possible to suppose that collusion behaviors will be easily implemented when a reduced number of firms dominate the market. Fagundes and Pondé (1998) complement this reasoning affirming that in concentrated markets, consequently, the potential competition intensity, inversely proportional to the magnitude of existent entrance barriers, is crucial in the observed acting determination.

Bain (1956) affirms that if exist high barriers to the entrance [in market], there will be conditions to established firms exercise the monopoly power, allowing that a company makes an elevation prices politics. On the other hand, if market is atomized and entrance and exit barriers don't exist, firms will have little space for the process elevation. This is a brief explanation in the way as market structure determines the firms' strategic decision.

The indices concentration intend to capture what forms the economic agents present a dominant behavior in certain market, and in this way different indicators consider agents' market participations, second different judiciousness approaches. Industrial concentration indices are useful to indicate preliminarily the sections for which it is waited that the market power is significant (RESENDE; BOFF, 2002).

2.3.1 Concentration indices

By identifying concentration indices is possible to obtain a competition existing index in a determined market. The analysis indicates that as greater the concentration value, as lower the competition degree between firms, and more concentrated in one or few companies will be "virtual" industry market power (RESENDE; BOFF, 2002).

A virtual individual firm market power, as indicated by Resende and Boff (2002), is related to its ability to control the product sale price. More efficient organizations, which can produce at lower costs are easier than others to compete on price and occupy portions of the growing market through progressive reductions in the price. This is an important justification to use the concentration measures when analyzing the biodiesel market in Brazil.

The organization's ability to produce at lower prices is the main feature for the biodiesel producer success participation in auctions conducted by the ANP. This is because, provided that all other legal requirements are met, price is the determining factor to transaction realization.

The market power can be manifested through the various indicators analysis, such as: company market share and the stockholders equity, the installed capacity, the number of employees, etc. From the analysis of market shares distribution between firms crystallizes the market structure, which concentration indices should take into account not only the individual parcels level of the market, but also its distribution. Increased industrial concentration leads to greater inequality in the market between the companies (RESENDE; BOFF, 2002).

This study uses both concentration measures partial and summary. The partial concentration measures do not use all the enterprises data operating in consideration industry, but only a part of it, and the main example are the concentration reasons (concentration ratio - CR_k). The summary measures require data of all firms in operation and the main examples are the indices of concentration Herfindahl-Hirschman (HHI) and entropy (RESENDE; BOFF, 2002).

The concentration ratio of order k is a positive indicator that provides the market share of the largest companies k ($k = 1, 2, \dots, n$) in the industry and can be expressed by:

$$CR(k) = \sum_{i=1}^k \quad (1)$$

Resende and Boff (2002) explain that the higher the index value, the greater the market power exercised by the k largest firms. It is common use of $k = 4$ or $k = 8$, in other words, it considered only the participation of four or eight largest firms respectively, with the notation CR(4) or CR(8).

The two main criticisms of concentration ratio are: a) they ignore the presence of smaller companies $n-k$ industry, b) do not consider the relative share of each company in the k greater group. Thus, it is more difficult to use the CR(k) index as a market power measure, or the competition degree existing in the industry (RESENDE; BOFF, 2002).

The *HHI* index also is used for the analysis development. This is a positive index defined by:

$$HHI = \sum_{i=1}^n S_i^2 \quad (2)$$

When elevating each market portion to square the index supposes to attribute a relatively larger weight to larger companies. So, the greater is *HHI* the higher is the concentration and, therefore, smaller the competition among the producers. The *HHI* index ranges from $1/n$ and 1 , in the upper limit is associated with the extreme monopoly case. Observe that the lower limit of *HHI* decreases when increases the number of companies, but this does not mean that concentration always decreases when increasing number of companies (RESENDE; BOFF, 2002).

3. Research methods

This is an exploratory study, where data were collected and analyzed and the PNPB activities evolution is shown. More specifically the data were identified concerning the biodiesel production capacity currently authorized by the ANP, and data on the each company participation in the biodiesel purchase auctions accomplished until July of 2009.

Besides this consecrated data source, a solid rising was accomplished in secondary data source, such as scientific goods and books published that sustain the performed analyses. Documents and reports reviewed were accessed by Internet during the first half-yearly 2009. The main data source on the performed activities PNPB used for this study was on web site of ANP.

The reviewed reports were:

- Biodiesel Monthly Bulletin in June 2009;
- Pure biodiesel production worksheet - B100 (m³) was updated through the month of May 2009;
- Auctions conducted reports - from 1 to 14, and
- Web site list of "Biodiesel Production Plants Permitted Capacity" in June 2009.

The collected data were tabulated in Microsoft Excel ® spreadsheet and processed to enable the completion of the calculations needed to identify the indices of concentration CR(4), CR(8) and *HHI* adequately explained in the theoretical framework. Data analysis was performed using the crossing of the data obtained during the survey, by its interpretation in the light of the theoretical assumptions adopted and also agree with the proposed objectives for the study.

4. Findings

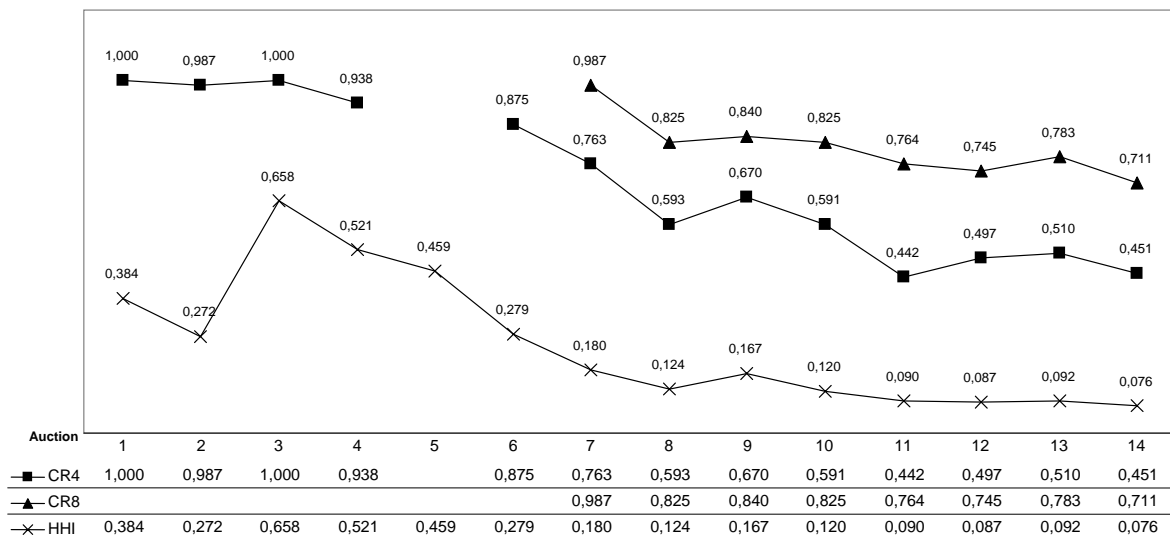
For its analysis were considered the managerial groups and not each unit in a separate way. In other words, companies that possess more than one productive plant had its data added, to facilitate the accomplished analyses understanding.

The accomplished analyses were segmented in two moments. In the first, data are presented and discussed the referring to biodiesel auctions results independent of biodiesel percentage addition to diesel. In the second, data was joined for validity of the biodiesel percentage addition period of different ones, what shows the concentration indexes evolution in agreement with the legal determinations.

This distinction shows that in the first analysis phase the concentration indexes reflect a general panorama of auctions accomplished in PNPB evolution. While the joined analysis reveals companies behavior in function of the demand increase specified by the government.

Figure 01 presents the evolution of concentration indices CR(4), CR(8) and *HHI* of all auctions accomplished until May 2009. To calculate concentration reasons CR(*k*) was identified the participation of *k* larger companies in relation to total commercialized volume. To *HHI* index the participation value of each company was elevated to square, attributing larger relative power to larger participation companies.

Figure 01: Concentration Indices in ANP Auctions



Source: elaborated by authors starting from ANP (2009).

In the first biodiesel auctions the number of participated companies was low, that can be visualized by the difficulty of accomplishing the referring calculations to the concentration indices. In the index CR(4) case there was not enough number of companies for its calculation in the fifth auction. Just starting from the seventh accomplished auction there was more than seven companies participation, allowing the CR(8) index calculations.

The index CR(4) behavior of the first four auctions demonstrated a very high concentration degree, representing practically the whole commercialized volume. Since the sixth auction the fall concentration tendency was accentuated that was of 32% between the sixth and the eighth auction,

passing of 87,5% for 59,3%, respectively. The period in that there was accentuated disconcentration movement was among the auctions of number 9 and 11, when the index CR(4) passed of 67% for 44,2%, a reduction of 34%. It stands out that among all the 14 auctions accomplished by ANP the 11th were what presented the smallest index CR(4).

In a general way the concentration ratio CR(4) behavior indicates that, with the PNPB maturing, the concentration regarding the participation of the companies in the auctions decreased considerably (54,9%). In the extreme cases they meet the first auction the CR(4) was 100% and in fourteenth auction the CR(4) was 45,1%.

The concentration ratio CR(8), as mentioned previously, could only be calculated starting from the 7th accomplished auction when the number of "managerial groups" sold biodiesel overcame 7 (seven). It is pointed out that, for ends of this analysis, the criterion of "managerial group" was used in that are gathered all the productive units that belong to the same company.

The concentration ratio CR(8) corroborates the results reached starting from the calculation of indicator CR(4). However, the comparison among the indexes CR(4) and CR(8) in the auction number 12 it indicates the occurrence of a movement in felt opposite. While the CR(4) presents a movement that reflects a concentration increase, the index CR(8) indicates a decrease in the same. This comparison allows us to infer that no matter how much the 4 larger companies have concentrated the largest portion of negotiated biodiesel volume, the commercialized total volume was better divided among the 8 (eight) larger groups, reflecting a possible inequality decrease in the market portions distribution among the companies that participated in the auction. This situation is also attested by the suitable accompaniment suitable *HHI* for the period, as will be discussed ahead.

The *HHI* index, for being a summary measure, demands to consider all the companies data of the sector and its respective participation portions in the market. Added to this the fact of attributing power to market portions, this indicator allows to identify the concentration level at industry so much as the degree of existent inequality in market portions distribution among the companies.

In the series of data analyzed is verified, as well as in the concentration reasons analyses, the sector disconcentration movement, ally to inequality representative decrease of market portions distribution among the companies. This means that, even if market concentration still exists, more companies participated of negotiations in a representative level to the sector. A possible positive consequence of this verification is that, theoretically, the more companies participate indeed of ANP biodiesel sales auctions, the familiar farmers amount involved in the productive process tends to be higher. To consequence tends to be better the PNPB result, where one of main objectives is an income creation to familiar agriculture.

The *HHI* index presented higher level in the 3rd (third) auction, having reached, standing out that the variation interval is $0 < HHI < 1$, the value of 0,658. It indicates that, besides little companies get to accomplish transactions, the largest negotiated volume was the position of just a company (80%) and characterizing the moment of larger inequality in the market portions distribution.

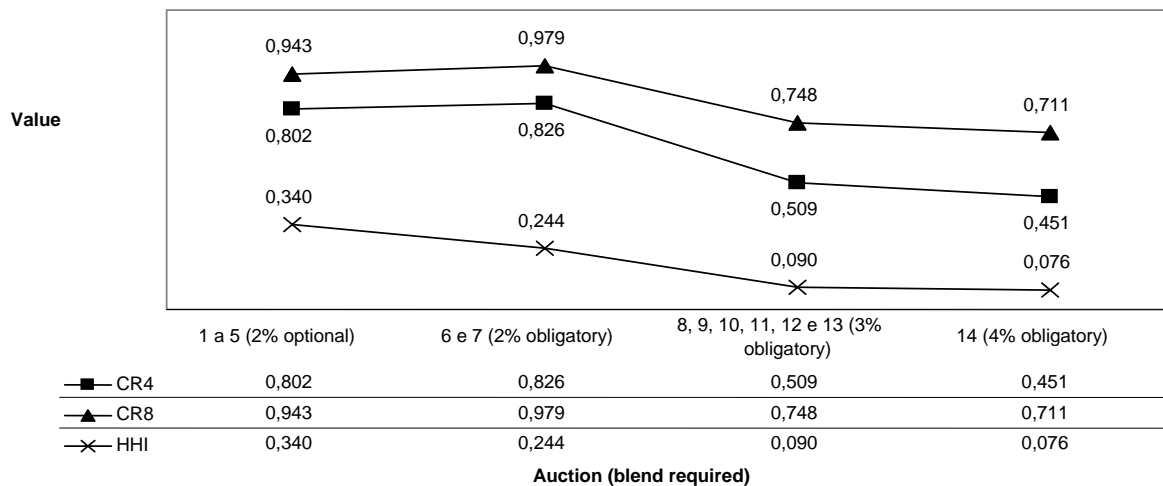
Between the third and the eighth auctions there were the most intense disconcentration movement and the inequality decreases in the ANP biodiesel auctions, when the reduction was 81,15% and *HHI* index reached the landing of 0,124. ever since the disconcentration movement continued but much more interesting intensity, tending to stabilization about the index 0,090.

One of the factors that explain this disconcentration movement verified by the index CR(4), CR(8) and *HHI* is the amount of companies increased the participation in the auctions and that got to make transactions. To exemplify this situation is enough the verification that in the first auction just

accomplished 4 (four) companies participated, in auction number 8 (eight) 14 companies participated and in the 14th (fourteenth) auction 30 (thirty) companies had sold its production.

In sequence, the auctions are analyzed in a joined way, using as criterion for the definition of the "clusters" the level of biodiesel and diesel combination legally demanded. Therefore they were certain 4 (four) groups of auctions, which are: a) accomplished auctions when the blend percentage was 2% optional (auctions from 1 to 5); b) period of 2% obligatory blend (auctions 6 and 7); c) period of 3% obligatory blend (auctions from 8 to 13); and, d) period of 4% obligatory blend even to present it dates (auction 14). The Figure 02 presents the values and the behavior of the indices CR (4), CR(8) and *HHI* for the determinated periods.

Figure 02: Joined Concentration Indices in ANP Auction



Source: elaborated by authors starting from ANP (2009).

As presented in the literature review section, PNPB was planned in way to promote a growing biodiesel insert to consuming market by its blend to mineral diesel. Starting from the concentration indices calculations adopted for this study, it is noticed that, accorded to waited by the biodiesel planning, the producers entered in the market when biodiesel blend level demanded by law increased.

The moment in that the government determines combination level increase between biodiesel and diesel a demand growth is being promoted for the product. It likes for the companies as an investment risks decrease process, where larger solidity of the program will exist and also better opportunities of profits accomplishment.

These verifications are evidenced by the CR(4), CR(8) and *HHI* indices behavior in that, to each new program apprenticeship, smaller became the concentration indices, which indicates better market portions distribution among the participate companies. The CR(4) and CR(8) indices began the disconcentration movement starting from the apprenticeship in that the biodiesel blend became obligatory in 2%, dropping drastically when the demanded blend passed at 3%, registering concentration of 50,9% and 74,8% respectively.

The *HHI* index, when accomplished the contained data analysis presents the disconcentration movement from the first combination period between diesel and biodiesel. The inequality, evident information offered by this index meets very reduced in the last two blend levels, once again indicating that more companies participated in the auctions and, in the same way, best divided the participation in the market.

In Table 02 the 14th (fourteenth) ANP auctions is compared and analyzed with the authorized production capacity according to bulletin of month June 2009 published by ANP. As told by Resende and Boff (2002) the market power can show for the market share of the companies that compose the sector, as well as other indicators. Among these other ones indicative is the analysis of company production capacity in relation to industry installed total.

Table 02 - Market participation comparative analyse and production capacity

14 Auctions result (4% - obrigatório)			Authorized Production Capacity Analyse		
Producer	Volume sold (M ³)	Participation	Company	Capacity (M ³ /day)	Participation per Company
1° Granol	61.000	13,26%	Brasil Ecodiesel	2070	17,32%
2° Brasil Ecodiesel	57.000	12,39%	Granol	1846,33	15,45%
3° ADM	49.100	10,67%	Biocapital	824	6,90%
4° Oleoplan	40.500	8,80%	ADM	682	5,71%
5° Petrobras	33.840	7,36%	Agrenco ¹	660	5,52%
6° Caramuru	30.000	6,52%	Oleoplan	660	5,52%
7° BSBIOS	28.500	6,20%	Caramuru	625	5,23%
8° Biocapital	27.000	5,87%	Petrobras	471	3,94%
Total	460.000	100%	Total	11.949,49	100%
¹ Don't have authorization to commercialize in the 14 th auction.					
CR4 Index		0,451	CR4 Index		0,454
CR8 Index		0,711	CR8 Index		0,656
HHI Index		0,076	HHI Index		0,079

Source: elaborated by authors starting from ANP (2009).

It was considered the 8 (eight) companies that possess the largest participation in each analysis section. It was just used the result of the 14th (fourteenth) auction because it is an informative picture and, also, for the auction that counted with the largest participant companies amount the most recent to present date.

It is noticed when analyzing the table there is just an alteration in the group of 8 (eight) larger companies in participation in the auction and in production capacity. The company "Agrenco" that possesses the 5th (fiveth) larger installed production capacity didn't possess the necessary authorization to commercialize its production in the date of 14th auction accomplishment.

On the other hand the company "BSBIOS" that appears as the holder of 7th (seventh) larger market portion in referred auction with 6,2%, at least illustration among the eight larger authorized production capacities for operation. The bulletin published by ANP in June 2009 informs that, in that date, there were 65 plants (production units) authorized for operation, of which 44 were authorized for biodiesel B100 commercialization, besides 12 new plants in authorization process and 8 plants in authorization process for amplification.

These verifications can, in its majority, be explained by the certain legal mechanisms for the operation on this market, such as the operation authorizations, commercialization authorizations

which depend on obtaining the stamp, besides the other environmental and social requirements to which the companies should assist.

When analyzing the concentration indices behavior, it is noticed that there is a similar behavior of the three indicators when the results of fourteenth 14th auction and the current authorized production capacity are compared. This fact indicates that the companies which are properly authorized to produce and executes the legal demands to obtain the authorization for commercialization count with few barriers (in function of largest companies market power) to participation in ANP auctions.

Thus, it is verified an industrial sector characterized by Oligopoly as market structure, but with a current moderated concentration index among the largest participant companies of section. Therefore the aconcentration indices analyses indicates that, as happens the biodiesel demand creation by legal determinations, more attractive become the investments from industries that possess the biodiesel production know how according to Production and Use of Biodiesel National Program legal demands.

5. Conclusion

Starting from the data rising accomplished to industrial concentration indexes analysis the participation of biodiesel industries in the purchase auctions promoted by the Petroleum, Natural Gas and Biofuels National Agency (ANP), it is ended that the predominant structure market in the sector is the Oligopoly. More specifically, now it is an oligopoly not much concentrated, where the universe of authorized companies to produce biodiesel is, in the date of this study accomplishment, composed by 65 (sixty five) companies, of the which 44 (forty four) are authorized to market its production by ANP auctions.

It is also concluded that, in spite of presenting a medium concentration degree, market distribution portions in the accomplished last auctions have still been turning less and less unequal according to *HHI* indicative historical analysis.

Along the section "Findings" the arguments were developed regarding the industrial concentration evolution according to PNPB objectives. In highest it stands out that, as PNPB is going consolidating and consummating the biodiesel demand creation starting from the legal determinations that regulate the biodiesel mixture to mineral diesel, larger amount of industries are shown disposed to accomplish the necessary investments for implantation of new production units.

Finally, the fact is stood out that industrial concentration level in this segment has been considerably decreasing and it still presents a larger disconcentration tendency. Increasing the biodiesel industrial units number it can be presumed that larger amount of rural producers, especially the familiar agriculture producing, needed to be inserted in this agroindustrial production system, tending to income creation for this social segment as foreseen in the National Program of Production and Use of Biodiesel objectives.

5.1 Limitations and future researches suggestions

The main limitation in this study was regarding to shortage of the data availability on the PNPB auctions results, being limited to consult ANP web site.

As suggestions for future researches: the deepening of the referring analyses to the commercialization mechanism (auction) determined for the biodiesel purchase; and the

accomplishment of studies about the location plants and its comparison to primary sources of raw materials used to biodiesel production.

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