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EFFICIENCY IN APPLICATION OF OIL ROYALTIES RESOURCES: IDENTIFICATION OF BENCHMARK BRAZILIAN MUNICIPALITIES

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ABSTRACT

In a context that presents an opportunity for academic discussion on the quality of receipt of oil royalty revenues and the efficiency in the use of these resources, research aims to identify which municipalities receiving oil royalties can be considered as benchmark in the application of budgetary resources. The relevance of this study lies in the academic and political discussions on the subject generated from the discovery of large oil reserves in the Brazilian territory and the consequent changes in the legislation on the model of sharing these resources. The Data Envelopment Analysis instrument (CCR model) was used to verify the efficiency in the allocation of public resources in 115 municipalities located throughout the Brazilian territorial extension, considering as input variables "tax revenues" and "current transfer revenues", and as a product-variable, the "Municipal Human Development Index", which was preceded by a cluster analysis. Results indicated that more than 70% of the investigated municipalities have an efficiency score of less than 0.4, suggesting a marked difference between the results achieved by the benchmark municipalities and the other municipalities not located at the efficiency frontier. These results are consistent with previous studies, which indicate that the resources destined to minimize the effects of negative externalities from oil extraction activities may not be generating the desired results regarding the improvement in human development of its receptors.

Keywords: *Oil royalties. Efficiency. Data Envelopment Analysis.*

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1 INTRODUCTION

Public budget, a primary tool for government management, is prepared based on premises defined mainly by government officials. It can be understood as the result of the allocation of public resources, taking in consideration political, legal, accounting, economic, financial and administrative aspects (Castro, 2011; Giacomoni, 2012; Jones & Pendlebury, 2010).

Among these premises, there are government transfers, present since the 1946 Constitution, with the objective of promoting the reduction of regional inequalities, equalizing individual incomes and promoting socioeconomic balance between municipalities, contributing to the promotion of social justice and increasing the effectiveness of government actions (Arretche, 2004; Tribunal de Contas da União, 2008).

Constitutional government transfers include financial compensation, made through royalties from oil and natural gas, from mandatory payments made by exploratory companies, rents distributed by the Union to federal entities, based on Art. 20 of the Federal Constitution and Law No. 9,478/1997 (Tribunal de Contas da União, 2008).

At the end of 2007, with the announcement of the discovery of large oil reserves in the region called "pre-salt", there had been new debates, in the political sphere and in society, about the need to review this legal framework (Queiroz & Postali, 2010; Seabra, Freitas, Polette, & Casillas, 2011). Supporters of this review alleged arguments about the ownership of the Union – not states and municipalities – over the deposits, in addition to the alleged creation of "emirates" led by "sheiks" – in reference to the countries of the Middle East, known for the abundance of oil reserves – in regions benefiting from oil *royalties* as a result of the current sharing model. With these arguments, they pointed out the mismatch between the allocation of oil revenues in favor of such federative entities, and the goal of resolving the effects of negative externalities arising from this activity (Queiroz & Postali, 2010; Serra, Terra, & Pontes, 2006).

The controversy over the redistribution of rents from oil was exacerbated as of 2009, when the government discussed a new regulatory framework for the production sharing of newly discovered oil reserves, through the so-called Ibsen Pinheiro Amendment (Amendment No. 387/2009 to Bill No. 5,938/2009). The Amendment provided for the establishment of the same criteria as the Municipality Participation Fund for the distribution of oil *royalties* and with scope for existing contracts, benefiting federative entities considered "non-producers" and greatly reducing the incomes of current beneficiaries (especially Rio de Janeiro, Rio Grande do Norte and Espírito Santo). Its presentation culminated in political protests, which reflected in the positioning of press bodies – which summed up the debate on the matter to a war between producing and non-producing states –, causing popular commotion in the localities affected by the new distribution (Carnicelli & Postali , 2009; Maia, Terra, & Matta, 2014).

As a result, the new Petroleum Law (Law No. 12,734/2012) has been published, however the section referring to the Ibsen Pinheiro Amendment became the object of Direct Unconstitutionality Action in the states of São Paulo, Rio de Janeiro and Espírito Santo with the Supreme Court Federal Court, causing the new rules inserted by the amendment to be provisionally suspended (Maia et al., 2014). Thus, the issue involving the way of calculating the distribution of income from oil royalties has not been pacified. This can be perceived with the proposal put into public consultation by the National Petroleum Agency in 2015, regarding new changes in the calculation of royalties distributions to federal entities. It ended up being suspended in 2016 by the Ministry of Mines and Energy, whose approval could benefit the state of Rio de Janeiro, which now faces financial difficulties, largely due to the low price of the *commodity* (Alvarenga, 2016; Pamplona, 2016, 2017).

Experts consider that, despite the behavior of the media, which reduced the controversy over oil royalties to a battle between states, with the aim of forming opinions and influencing a certain part of society, the context presented an opportunity to discuss receiving quality of revenues and the efficiency in the application of these resources, which would be more relevant (Maia et al., 2014). Evidence has been pointed out in the academic literature, municipalities that

receive oil royalties have shown losses in efficiency in the production of social indicators (Freitas, 2013) and in municipal administrative management (Froemming, 2015; Postali, 2012), thus not contributing significantly to improve development indicators (Caçador & Monte, 2013).

In this context, it is important to carry out studies that identify reference municipalities for those who are using these resources inefficiently and compromising the compliance with the constitutional principle of efficiency in Public Administration. This investigation, therefore, seeks to answer the following question: **which are the municipalities that receive oil royalties and may be considered a reference in the application of budgetary resources?** Thus, this research aims on identifying Brazilian municipalities which receive oil royalties that can be considered a reference for the efficiency in the use of budgetary resources for other Brazilian municipalities that receive such compensations.

The research is initially justified by the need to deepen the debate on the current rules for the distribution of oil royalties among federal entities, especially regarding the efficiency in the application of these resources. According to the experienced context, this debate gained greater relevance considering the discovery of large oil reserves in the region known as the pre-salt and the consequent changes in the legislation of the sharing model that have placed, on opposite sides, the federative entities considered producers and non-producers, as presented in the context. Therefore, studies that evaluate the effects generated by these resources may support the debate about the sharing model (Maia et al., 2014; Postali & Nishijima, 2011), contributing to the fulfillment of this budgetary premise which aims to achieve the goals of the Public Administration, especially the need to reduce social inequalities (Queiroz & Postali, 2010; Silva & França, 2009).

Regarding the existing academic literature on the subject, the review of the theoretical-empirical framework revealed some related studies that dealt with the impacts of oil royalties on the Human Development Index (HDI) of the producing municipalities located in the Recôncavo Baiano (Reis *et al* ., 2005); the relationship between the distribution of royalties and municipal GDP per capita (Postali, 2007); the impact of royalties on GDP per capita of municipalities in the state of Espírito Santo (Ribeiro, Teixeira, & Gutierrez, 2010); and assessing whether the distribution of royalties contributed to the improvement of human development in the receiving municipalities through the Firjan Social Development Index (IFDM) (Postali & Nishijima, 2011). This study differs from those, especially when evaluating the use of the resources by the municipalities considered producers, from the perspective of technical efficiency, with national coverage and with use of the Municipal Human Development Index (MHDI) as an element of identification of the development of Brazilian municipalities.

Still, while considering the study by Givisiez and Oliveira (2011) on the relationship between oil revenues and the efficiency of allocation in education with the use of indicators related to the theme in municipalities in the northern region of the state of Rio de Janeiro, this study differs by expanding the analysis of the efficiency of the application of royalty resources with the use of the MHDI, which considers in its calculation, in addition to education, aspects related to longevity and income, as well as for carrying out this analysis on a national scope.

2 LITERATURE REVIEW

2.1 Theory of social welfare and *royalties*

Considering the role of the State in the search for the common good for society and valuing the efficiency in the use of public resources, from the perspective of the theory of social well-being, state intervention is necessary in order to avoid inefficiencies in the allocation of resources resulting from failures of market (Estevez-Abe, Iversen, & Soskice, 1999; Farina, Azevedo, & Saez, 1997; Scarpin & Slomski, 2007). Among the causes of market failures that

require state intervention are positive and negative externalities (Baumol, 1972; Farina *et al*., 1997; Jones & Pendlebury, 2010).

Positive externalities are linked to the inability of private appropriation of made investments, leading society to underinvestment and requiring the State to intervene in order to encourage innovation by guaranteeing private returns (through patents, for example). Negative externalities are linked to the damage caused to the environment by certain activities and, which are not directly assumed by economic agents in the form of costs, may compromise the quality of life of society and require the State to intervene to repair or control such damage through regulations, restrictions or financial compensation (Farina et al., 1997; Scarpin & Slomski, 2007; Silva & Lucena, 2011).

Among the activities that generate negative externalities are those related to oil production. This industry can bring very worrying environmental impacts to society, such as risks of oil spills at the sea, pollution and environmental degradation, deforestation, impacts on marine and terrestrial ecosystems, species extinction and pressures on natural environment (Silva & Lucena, 2011).

In this sense, the collection of royalties from producing entities in favor of the State, represents compensation for possible environmental damage resulting from the exploitation of fuel (Queiroz & Postali, 2010). Considering this situation, from the 1970s onwards, the Brazilian State established criteria for the distribution of oil royalties collected among federal entities, taking into account the territories negatively impacted by oil activity, that is, the physical criterion adopted since then for allocation of oil *royalties*, has as main beneficiaries the locations with greater proximity to the exploration fields, even if these fields are located on the continental shelf (Serra & Fernandes, 2005).

In addition, oil is characterized as an asset of decreasing value. Once being a non-renewable resource, the greater its consumption at present, the lower will be the future economic benefits generated by this asset (Hotelling, 1931; Hartwick, 1977). Based on this conception, royalties on oil also consist of compensation to municipalities for the use of their production factor in the present, with a view to maintaining the level of capital in the future (Postali & Nishijima, 2011). Thus, according to Hartwick (1977), the income from non-renewable resources must be reinvested in assets that provide the recomposition of the consumed capital and the maintenance of society's wealth.

In this sense, the efficient management of public resources is fundamental for the maintenance and elevation of social well-being. With appropriate allocation of resources, fundamental human rights can be respected (access to education, health, infrastructure, dignity, among others). Thus, economic development indicators, such as the HDI, tend to be positively impacted (Hirschman, 1977; Sen, 2000). However, in case of mismanagement of public revenues – which is more likely in locations with weak institutions –, the increase in the level of financial resources resulting from royalties can cause an increase in corruption, rent-seeking behavior, the adoption of clientelism strategies and the use of resources for political purposes, having null or even negative effects on economic development. This effect is known as the "natural resource curse" (Robinson, Torvik, & Verdier, 2006; Rocchi, Landi, Stefani, Romano, & Cozzi, 2015).

Regarding the apparatus constituted by the Brazilian State to promote the regulation of petroleum activity in its territory, the role of the *Federal Constitution* of 1988 stands out initially in indicating the role of public power in the preservation of environmental resources, as well as in guaranteeing the participation of entities in the results of oil exploration. Then, Law No. 9,478/1997 established the National Petroleum Agency as the body responsible for regulation in the oil sector, which dealt with the royalty rates applicable to exploration companies, as well as provided guidelines for calculating the sharing of these royalties between the Union, states and municipalities (Silva & Lucena, 2011; Federal Audit Court, 2008). Finally, among the main

regulatory pieces in the sector, we present Law No. 12,734/2012, which, motivated by the discovery of large oil reserves in a region located on a continental shelf called the pre-salt, redefined the system of sharing royalties and, therefore, the participation of those considered to be producers has drastically decreased (Maia et al., 2014).

2.2 Management control tools in the Brazilian State

The role of the State includes the promotion of social welfare, leading to the need of developing instruments that may control possible negative externalities in the form of regulations and financial compensation. Considering also the principles of Public Administration that determine, among other factors, the search for efficiency (Castro, 2011), the public power should use instruments that monitor whether the objectives of the administration are being reached, including tools that evaluate if the actions taken to mitigate market failures are being effective.

Within this scope, are included the tools of accounting and management control (Borges & Matias, 2011; Frezatti, 2007) which are able to identify, prepare, interpret and communicate information that enables managers to make decisions in search of achieving the pre-established objectives, thus enabling organizational control (Horngren, Sundem, & Stratton, 2004). Among the existing accounting and management control tools to support managers, the budget stands out (Coombs, Hobbs, & Jenkins, 2005; Frezatti, 2007).

Considered the main tool for management control (Hofstede, 1981) and basic tool for Public Administration (Jones & Pendlebury, 2010), the budget has the capacity of supporting the entire management process of an entity, whether public or private, which gives it an important role in the planning and control of managerial actions (Padoveze, 2012). In the context of Brazilian Public Administration, the budget plays a central role in the execution and monitoring of the actions planned by the State through the PPA, LDO and LOA (Borges & Matias, 2011; Castro, 2011) which, acting in an integrated manner, also reflects the premises already advocated by law for the distribution of resources, such as the sharing models for oil *royalties*.

Likewise, considering the goal of the Public Administration of promoting social welfare, other indicators may be used to assess the performance of the State from this perspective. The HDI is considered a summary measure that demonstrates, for a given territory, the reach of human development in three dimensions: (i) access to knowledge, (ii) long and healthy life and (iii) standard of living. The result of the indicator, which ranges from zero to one, indicates that the closer to one, the greater the human development in that location. In this sense, the HDI may be viewed by the public manager as information that demonstrates the effectiveness of the actions of the government in maximizing the well-being of citizens, making up an indicator that must be monitored in order to being able to manage public finances properly, and so that the possibilities of success in the application of public policies get expanded. It is, therefore, a tool that may be used in governmental controllership (Scarpin & Slomski, 2007).

2.3 Related studies

Previous studies sought to assess the relationship between the budgetary and financial resources highlighted through the LOA, with emphasis on the entities that receive resources from oil royalties, with indicators that demonstrate the level of human development in these regions. The investigation made by Reis et al. (2005) sought, in a given territorial range – the Recôncavo Baiano basin –, to verify the impact of receiving oil *royalties* on human development, using the HDI of year 2000 for this goal. The results of the undertaken research indicated that, despite the receipt of these resources, it was not possible to verify a relationship between the collection of oil revenues and the increase in human development in the given studied region. Still, the authors added among their considerations, that the collection of revenues at different levels due to receipt of oil royalties does not automatically represent an increase in the quality of life of the citizens,

so the management of the resources received a decisive factor for the resources destined to bring about the desired effect.

As for Postali and Nishijima (2011), they sought to verify whether the oil royalties distributed to Brazilian municipalities had a positive contribution to the human development of the contemplated municipalities. The analysis, based on information of the period in between 2000 and 2007, used IFDM as a measurement of social development. The obtained results suggest that, despite the increase in municipal revenues due to the receipt of oil revenues, the social indicators in the areas of education, health and work did not show significantly different results in comparison to municipalities in the same control group that do not receive *royalties* from petroleum.

More narrowly, Givisiez and Oliveira (2011) sought to assess the impacts on the education indicators, of municipalities that receive oil *royalties* located in the northern region of Rio de Janeiro. In this study, the hypothesis that budget advantages perceived by these municipalities have not fostered better results in education indicators was confirmed. Similarly, the study by Caçador and Monte (2013) was carried out on Espírito Santo municipalities, in the period between 2000 and 2009, and, having considered the IFDM as a development measure, indicated that the receipt of oil royalties did not contribute significantly to improve the social indicators of these municipalities.

In the same line, the study by Freitas (2013), which investigated whether the increase in oil revenues in Brazilian municipalities contributes positively to the improvement of social indicators, is also cited. Using as inputs of the model the GDP per capita and the population, and as products the completeness rate of basic education, the sanitation rate, the electric coverage rate and the number of health facilities per 100 thousand inhabitants, the results of the investigation indicated an inverse relationship between oil revenues and efficiency in generating social indicators.

Seeking to verify the existence of inefficiencies in municipal management resulting from the receipt of oil income, specifically on the effort to maximize tax and optimize administrative expenses, Postali (2012) investigated about 5,000 Brazilian municipalities between the years 2002 and 2009 and identified the existence of these incomes is associated with the inefficiency of the municipal administrative management with regard to the optimization of administrative expenses, while the fiscal effort was not significantly affected by royalties.

Froemming (2015), in a similar study, evaluated the existence of relaxation in the fiscal effort and increased inefficiency of administrative management in 56 municipalities of the state of São Paulo, in the period between 2005 and 2012. Likewise, the investigation has not identified significant differences in the fiscal effort of municipalities benefiting from oil revenues, however it pointed out to an increase in the inefficiency of the municipal administrative management.

In contrast to the results observed in the studies listed, Martinez and Reis (2016) investigated the impact of receiving oil *royalties* on the Basic Education Development Index (Ideb) of 67 municipalities in Espírito Santo between the years 2006 and 2013. Using panel data regressions, the authors indicated the existence of a positive association between the variables, that is, that the Ideb score increases as the oil royalty revenues of the analyzed municipalities increase.

3 METHODOLOGICAL PROCEDURES

This investigation was made possible by obtaining secondary data (Martins & Theóphilo, 2007), collected through the "Finance of Brazil" database, a tool developed by the National Treasury Secretariat that contains accounting data from Brazilian municipalities related to budget execution and to the patrimonial situation of these federative entities (Tesouro Nacional, 2016), in addition to considering data from the *Atlas of human development in Brazil*, a tool that offers data on the MHDI of each Brazilian municipality and more than 180 indicators extracted from

the Demographic Censuses already carried out in the territory (Atlas Brasil, 2016). The investigation, with *ex-post-facto* effects, was carried out considering a longitudinal time dimension (Cooper & Schindler, 2003).

Considering the availability of data in the aforementioned sources, the investigation had as its object the period between the years 2002 and 2010, especially due to the fact that the most recent MHDI is relative to the year 2010. As for the definition of the sample of municipalities, it was noted at first that not all municipalities passed on information for the formation of the "Finances of Brazil" database for the entire delimited period. Thus, out of a total of 5,570 municipalities, 4,127 municipalities have been identified with complete information between the years 2002 and 2010.

In a second step, considering that in several municipalities the amount received from the quota of oil *royalties* might be considered irrelevant compared to the current revenues of the municipality (in particular, tax revenues and current transfers), thus having a low impact on its budget, in this study, we chose to carry out the analysis based on municipalities that had a proportion equal to or greater than 5% of their average revenues from oil *royalties* (obtained with the sum of the items "oil quota", "oil royalties share" ","Surplus royalties quota","special participation royalties quota"and "production royalties quota") in comparison to the sum of the average of its tax revenues, and revenues from current transfers in the period analyzed. Such a filtering resulted in a total of 117 municipalities to be analyzed, which make up the sample of this research.

The procedures adopted for data analysis have been subdivided into two stages: the analysis of *clusters* and the analysis of technical efficiency. The analysis of *clusters* aimed to stratify the 117 municipalities objects of the study, grouping them according to similar characteristics and enabling an analysis of efficiency of the municipalities with greater reliability (Costa, Ferreira, Braga, & Abrantes, 2015).

As for the grouping of municipalities into *clusters*, the following variables have been considered, extracted from the "Finance of Brazil" database, considering the period between 2002 and 2010: (i) average population; (ii) average annual revenue from oil *royalties*; and (iii) dependence on oil *royalties* (here represented by the division between the average annual revenue from oil *royalties*, and the sum of the average annual revenue from current and tax transfers). For the formation of *clusters*, this given protocol has been followed: (i) standardization of the three variables (*z-score*); (ii) carrying out the classification by hierarchical *cluster* according to the Ward method; and (iii) verification of statistically significant differences between the means of the groups, with the application of the t test (for two *clusters*) and unidirectional Anova with *post hoc* tests of Tukey and Tamhane (for more than two *clusters*). For such, we used the software Statistical Package for the Social Sciences® (SPSS), version 22.

With the definition of *clusters*, the technical efficiency analysis has been followed. The efficiency evaluation has been carried out using the Data Envelopment Analysis (DEA) method, already employed in several studies, to verify the efficiency in the allocation of public resources, with wide academic acceptance and simple interpretation of results (Costa *et al*., 2015) . International studies have recently used this methodology to assess efficiency in the allocation of public resources from different perspectives, having as object, for example, the public health systems of countries belonging to the Organization for Economic Cooperation and Development (OECD) (Cetin & Bahce, 2016), public education institutions in India (Kaur & Bhalla, 2017) and expenses directed to basic science and mathematics education in China (Si & Qiao, 2017).

The DEA is based on non-parametric mathematical models, that is, it does not use statistical inference, measures of central tendency, coefficient tests or regression analyzes, nor does it require functional relationships between inputs and products. On the other hand, the DEA, which aims to evaluate the performance of organizations and activities through measures of technical efficiency, is based on fundamentals of the theory of microeconomic production and is considered a method of powerful practical application of this theory in the evaluation of

performance of production units, both for profitable and beneficial activities (Ferreira & Gomes, 2009).

As for the model, we opted for the CCR model (Charnes, Cooper, & Rhodes, 1978), with orientation to input, by means of such it is possible to identify the global efficiency and the sources of inefficiency (Casa Nova & Santos, 2008), since its measurement is based on the reduction of inputs (Ferreira & Gomes, 2009).

As for the model application, Brazilian municipalities have been considered as productive units (DMUs), as input variables (i) the average tax revenue of the period between 2002 and 2010 and (ii) the average current transfer revenue of the period between 2002 and 2010, both extracted from the "Finance of Brazil" databases, and as a product variable the MHDI (Maciel, Piza, & Penoff, 2009), in turn extracted from the *Atlas of human development in Brazil*, referring to the year 2010. The MHDI is composed of indicators that focus on the same human development perspectives as the global HDI (long and healthy life, access to knowledge and standard of living), with an index ranging from zero to one where, the closer to one, the greater the human development of the municipality (UNDP, 2019).

For the model execution, the MaxDEA for Data Envelopment Analysis® *software* has been employed, developed on Microsoft Access® platform, and the execution has been performed for each *cluster* formed in the previous step.

By means of this *software*, in addition to identifying the technical efficiency of each municipality and detaching the benchmark municipalities, it was also possible to identify the amount of inputs that could be saved if the municipality not located on the efficiency frontier obtained the same efficiency as the benchmark municipalities, whereas the measurement of input-oriented technical efficiency also seeks to show how much the quantity of inputs could be proportionally reduced, without changing the quantities produced (Ferreira & Gomes, 2009). This information provided by the DEA methodology, which indicates, by means of the use of optimization of linear programming, the occurrence of usage of inputs beyond necessary, or production below the adequate level, gets called "slack" (Ferreira & Gomes, 2009).

4 DATA ANALYSIS

4.1 Clusters Analysis

Initially, we present the description and profile of the sample of 117 municipalities considered for this study. The set of municipalities has an average population of 41,589 inhabitants (minimum: 4,213; maximum: 474,662), with an average annual revenue from oil *royalties* of R$ 10,429,052 (minimum: R$ 429,732; maximum: R$ 275,613,756), an average revenue from current transfers of R$ 46,573,661 (minimum: R$ 6,705,310; maximum: R$ 508,164,660) and an average tax revenue of R$ 10,084,286 (minimum: R$ 80,537.77; maximum: R$ 281,978,683), in addition to an average dependence on oil *royalty* funds of 14.09% (minimum: 5.03%; maximum: 68.23%).

As for the geographic locations, 43% of the municipalities in the sample (fifty municipalities) are located in Rio de Janeiro, 10% (twelve) in Rio Grande do Norte, 10% (twelve) in Sergipe, 9% (ten) in Bahia, 5% (six) in Alagoas, 5% (six) in Espírito Santo and 4% (five) in Ceará. The other municipalities are located in the following states: São Paulo (four), Rio Grande do Sul (four), Santa Catarina (three), Paraná (two), Pernambuco (one), Minas Gerais (one) and Goiás (one).

Finally, regarding the MHDI, the sample has an average index of 0.677, with 0.525 being the minimum sample index for the municipality of Olho D'Água do Casado (Alagoas) and 0.837 the maximum index, obtained by the municipality of Niterói (Rio de Janeiro).

As for the *cluster* analysis, have been taken into consideration the sample of 117 municipalities, and the variables average annual population (hereinafter, population), average

annual revenue with oil *royalties* (R$) (hereinafter, *royalties*) and the ratio between the average annual revenue with oil *royalties* (R$) and the sum of tax revenue and revenue from average transfers (hereinafter, dependence), as presented in the methodology. A first analysis carried out by the SPSS® *software* indicated the existence of two to three *clusters* in the sample.

The scenario of two *clusters* indicated *cluster* 1 with 115 municipalities and *cluster* 2 with two municipalities, given that the t test of independent samples showed a significant difference, at the level of 5%, between groups only for the dependency variable (sig. = 0.000; df = 115), and non-significant differences for the variables population (sig. = 0.067; df = 115) and *royalties* (sig. = 0.090; df = 1.001). The scenario with three *clusters* indicated a *cluster* 1 with one hundred municipalities, a *cluster* 2 with fifteen municipalities and a *cluster* 3 with two municipalities (the same municipalities in *cluster* 2 of the two-group scenario), and the unidirectional Anova test indicated the existence of significant differences between groups for the three variables. In addition, Tukey's *post hoc* test has been performed for the dependency variable (sig. = 0.071 in the Levene homogeneity test of variances), indicating non-significant differences at 5% only for groups 1 and 2. The Tamhane *post hoc* test has been applied to the other variables (sig. = 0.000 in the Levene homogeneity test of variances), and for the variables population and *royalties*, statistically significant differences have been found only in groups 1 and 2.

Based on this first analysis, the presence of outliers in the sample is indicated, with the municipalities destined for group 2 in the scenario of two *clusters* and for group 3 in the scenario of three *clusters*. The two municipalities that got located in a different group in the two carried out scenarios were Macaé (RJ) and Rio das Ostras (RJ). Thus, for a second analysis, a sample of 115 municipalities has been considered, excluding *outliers*. The new *cluster* analysis indicated the existence of two *clusters*, the first consisting of 99 municipalities and the second comprising sixteen municipalities. The differences between the *clusters* can be visualized in Figure 1, extracted from the SPSS® *software*.

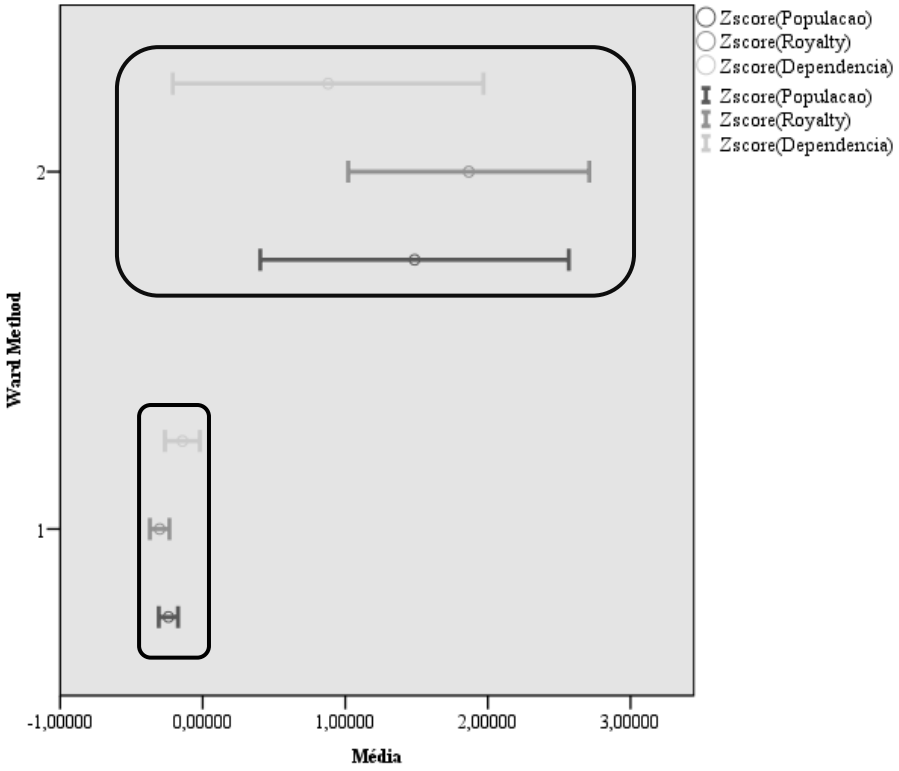

Figure 1. Characterization of coties by the variables population, royalties and dependence
Source: Research data.

As can be seen in Figure 1, the graphical representation indicates the formation of two *clusters*, which have significant differentiation between groups for the variables population and *royalties*. In order to confirm the discriminating elements between groups of municipalities, the t test of independent samples has been performed. The result of the t test is shown in Table 1.

Table 1
T-test results of independent samples by population, royalties, and dependency variables

Variable	Levene Test		T-test for equality of averages						
	Z	Sig.	t	df	Sig.	Average difference	Standard error	95% Interval	
								Inferior	Superior
Z-score (Population)	63.7	0.000	-7.973	113	0.000	-1.726	0.216	-2.155	-1.297
			-3.394	15.134	0.004	-1.726	0.508	-2.809	-0.642
Z-score (*Royalties*)	124.7	0.000	-12.179	113	0.000	-2.167	0.177	-2.520	-1.814
			-5.444	15.227	0.000	-2.167	0.398	-3.014	-1.319
Z-score (Dependency)	71.9	0.000	-4.038	113	0.000	-1.021	0.252	-1.522	-0.520
			-1.985	15.440	0.065	-1.021	0.514	-2.115	0.072

Source: Research data.

Therefore, as can be seen through Figure 1 and Table 1, the result of the analysis indicated the existence of statistically significant differences at 5% between the groups for the variables population and royalties, while for the variable dependence observed statistically significant difference at the level of 10%. In other words, two groups formed by cluster analysis can be discriminated in the sample in relation to cities that receive representative resources in their budget as oil royalties, which is explained by two characteristics: (i) the size of its population and (ii) the amount received from oil royalty revenues. The cities analyzed according to their clusters are identified in Figure 2.

Group 1									
City	**State**	**City**	**State**	**City**	**State**	**City**	**State**	**City**	**State**
Coruripe	AL	Trairi	CE	Iguaba Grande	RJ	São José de Ubá	RJ	Imbé	RS
Feliz Deserto	AL	Fundão	ES	Italva	RJ	São José do Vale do Rio Preto	RJ	Osório	RS
Olho d'Água do Casado	AL	Itapemirim	ES	Itaocara	RJ	São Pedro da Aldeia	RJ	Tramandaí	RS
Pilar	AL	Jaguaré	ES	Itaperuna	RJ	São Sebastião do Alto	RJ	Balneário Barra do Sul	SC
São Miguel dos Campos	AL	Marataízes	ES	Macuco	RJ	Saquarema	RJ	Garuva	SC
Satuba	AL	Corumbaíba	GO	Mangaratiba	RJ	Sumidouro	RJ	São Francisco do Sul	SC
Cairu	BA	Abadia dos Dourados	MG	Mendes	RJ	Tanguá	RJ	Barra dos Coqueiros	SE
Cardeal da Silva	BA	Itambé	PE	Miguel Pereira	RJ	Trajano de Morais	RJ	Brejo Grande	SE
Catu	BA	Matinhos	PR	Natividade	RJ	Açu	RN	Capela	SE
Entre Rios	BA	Porto Barreiro	PR	Paracambi	RJ	Alto do Rodrigues	RN	Indiaroba	SE
Itanagra	BA	Barra do Pirai	RJ	Pati do Alferes	RJ	Apodi	RN	Japaratuba	SE
Madre de Deus	BA	Bom Jardim	RJ	Pinheiral	RJ	Areia Branca	RN	Maruim	SE
Pojuca	BA	Bom Jesus do Itabapoana	RJ	Pirai	RJ	Caraúbas	RN	Pacatuba	SE
Santo Amaro	BA	Cachoeiras de Macacu	RJ	Porciúncula	RJ	Goianinha	RN	Pirambu	SE

São Sebastião do Passe	BA	Cantagalo	RJ	Rio Claro	RJ	Macaíba	RN	Rosário do Catete	SE
Saubara	BA	Cardoso Moreira	RJ	Rio das Flores	RJ	Pendências	RN	Santa Luzia do Itanhy	SE
Amontada	CE	Carmo	RJ	Santa Maria Madalena	RJ	Porto do Mangue	RN	Santo Amaro das Brotas	SE
Aracati	CE	Conceição de Macabu	RJ	Santo Antônio de Pádua	RJ	São Gonçalo do Amarante	RN	Guararema	SP
Icapuí	CE	Cordeiro	RJ	São Fidelis	RJ	Upanema	RN	Ilhabela	SP
São Gonçalo do Amarante	CE	Eng. Paulo de Frontin	RJ	São Francisco de Itabapoana	RJ	Cidreira	RS		
Group 2									
City	**State**	**City**	**State**	**City**	**State**	**City**	**State**	**City**	**State**
Presidente Kennedy	ES	Barra Mansa	RJ	Maricá	RJ	Paraty	RJ	Carmópolis	SE
São Mateus	ES	Casimiro de Abreu	RJ	Nilópolis	RJ	Queimados	RJ	Caraguatatuba	SP
Angra dos Reis	RJ	Magé	RJ	Niterói	RJ	Mossoró	RN	São Sebastião	SP
Armação de Búzios	RJ								

Figure 2. Cities analyzed according to clusters
Source: Research data.

4.2 Technical efficiency analysis

With the determination of the number of *clusters* and the classification of municipalities in each of the identified *clusters*, the application of Data Envelopment Analysis has been performed by means of the MaxDEA® *software*. For such, data enveloping has been performed for each of the formed *clusters*, considering the variables described in the methodology. This process resulted in the presentation of efficiency scores for each municipality, with the highest score (score = 1) indicating the reference municipalities to the other municipalities (benchmark), that is, with greater technical efficiency, while lower scores (closer to zero) indicate municipalities with opportunities for improving technical efficiency. That is, the lower the score, the lower the technical efficiency. The summary of the results found is reported in Table 2.

Table 2
Scores by *cluster*

Score	**Amount**		**%**		**Total**	
	***Cluster* 1**	***Cluster* 2**	***Cluster* 1**	***Cluster* 2**		
1	3	2	3.03%	12.50%	5	4.35%
0.90 to 0.99	0	0	0.00%	0.00%	0	0.00%
0.80 to 0.89	1	0	1.01%	0.00%	1	0.87%
0.70 to 0.79	3	0	3.03%	0.00%	3	2.61%
0.60 to 0.69	4	1	4.04%	6.25%	5	4.35%
0.50 to 0.59	6	2	6.06%	12.50%	8	6.96%
0.40 to 0.49	8	2	8.08%	12.50%	10	8.70%
0.30 to 0.39	21	3	21.21%	18.75%	24	20.87%
0.20 to 0.29	27	3	27.27%	18.75%	30	26.09%
0.10 to 0.19	24	3	24.24%	18.75%	27	23.48%
0.00 to 0.09	2	0	2.02%	0.00%	2	1.74%
Total	**99**	**16**	**100%**	**100%**	**115**	**100%**

Source: Prepared by the authors.

We observe, based on Table 2, that most of the analyzed municipalities present efficiency scores between 0.1 and 0.39 (70.43%), a proportion that is slightly higher in the municipalities

belonging to *cluster* 1 (72, 73%), which in turn also has municipalities with an efficiency score below 0.1. Regarding the *benchmark* municipalities, that is, those identified as reference in each of the *clusters* (score equal to 1), the DEA model revealed three reference municipalities in *cluster* 1 and two in *cluster* 2. In group 1, the municipalities of Abadia dos Dourados (MG), Porto Barreiro (PR) and Olho d'Água do Casado (AL) have been identified as reference.

However, due to the distinctive characteristics between the municipalities belonging to the group, resulting from the variables included in the model, a municipality identified with a score of 1 can be considered *benchmarking* for a given municipality with whom it presents variables similarities, while for another municipality it cannot be pointed out as a reference for discrepancies of the behavior of the same variables. This information is also provided by the MaxDEA for Data Envelopment Analysis® *software*.

According to the results obtained for *cluster* 1, the municipality of Abadia dos Dourados (MG) can be considered as a reference for a greater number of municipalities in the *cluster* (96 municipalities; 97%; that is, all municipalities with a score below 1), while Porto Barreiro (PR) can be considered as a reference for 61 municipalities (61.6%). Olho d'Água do Casado (AL), despite having a score of 1, cannot be used as a *benchmark* for any other municipality in the group.

This result also highlights the fact that the municipality that has the largest MHDI in the *cluster* is not necessarily the most efficient municipality in the group, since, in *cluster* 1, Imbé (RS) is the municipality that has the largest MHDI [0.764] and, however, it presented an efficiency score of 0.411, with the municipality of Abadia dos Dourados (MG) being indicated as its *benchmark*.

In group 2, the municipalities of Carmópolis (SE) and Presidente Kennedy (ES) have been identified as references, with a score of 1. Among the two municipalities, Carmópolis (SE) is mentioned as a reference for a larger number of municipalities in *cluster* 2 (fourteen municipalities; 87.5%; that is, all municipalities with a score below 1) compared to Presidente Kennedy (ES) (nine municipalities; 56.3%). As observed in *cluster* 1, the municipality that has the largest MHDI in the *cluster* also is not the most efficient municipality in the group. Niterói (RJ), the municipality with the highest MHDI (0.837) in *cluster* 2, obtained an efficiency score of 0.113 in this analysis.

The analysis by data envelopment also revealed the radial movements and the movements for *input* clearance for each of the municipalities not located in the efficiency frontier. That is, because the model has been executed with *input* orientation, the amount per *input* that could be saved to obtain a certain *output* (in this case, the result obtained by the municipality in the MHDI) is indicated, if this DMU had the same efficiency as the municipality considered as a *benchmark*. Table 3 summarizes this information by *clusters*.

Table 3
Negative radial and clearance movements of non-benchmark cities, by cluster

Movements (average)	***Number of occurrences***		***Average per occurrence (in BRL)***		
	***Cluster* 1**	***Cluster 2***	***Cluster* 1**	***Cluster 2***	**General**
Tax Revenue (radial)	96	14	2,838,896.21	34,963,099.83	6,927,431.22
Tax Revenue (clearance)	35	5	908,256.96	9,072,799.50	1,928,824.78
Tax Revenue (total)	**96**	**14**	**3,170,031.56**	**38,203,385.37**	**7,628,822.05**
Current Transfers (radial)	96	14	22,033,109.76	94,329,208.33	31,234,431.40
Current Transfers (clearance)	0	0	0	0	0
Current Transfers (total)	**96**	**14**	**22,033,109.76**	**94,329,208.33**	**31,234,431.40**

Source: Research data.

Referring to the information contained in Table 3, we observe that, on average, a municipality belonging to Group 1, whether it presents the same efficiency as the municipalities considered *benchmark* in this *cluster*, could employ around R$ 3.2 million in less tax revenue

and R$ 22 million in current transfers, in order to obtain the same MHDI, while a Group 2 municipality, on average, could have obtained the same MHDI with R$ 38.2 million in tax revenues and R$ 94.3 million in less current transfers, if it had the same efficiency as the *benchmark* municipality in its group.

It is observed, therefore, that even with a smaller number of municipalities, *cluster* 2 has, on average, revenues that could be used more efficiently, in absolute amounts, more expressive than the average presented in *cluster* 1. In general terms, each municipality could employ R$ 7.6 million of its tax revenues and R$ 31.2 million from current transfers in order to obtain the same MHDI, if they were efficient in using resources in the same way as the *benchmark* municipalities.

It is also interesting to note that the negative radial movements and clearances are more accentuated, in monetary terms, among current transfers, a group in which government transfers are included as oil *royalties*. We clarify that the negative radial movements refer to the radial distance of the DMUs to the efficiency frontier, indicating technical inefficiency (Souza & Wilhelm, 2009), while it is emphasized that the clearances represent the use of *inputs* beyond necessary (Ferreira & Gomes, 2009).

Regarding the municipalities considered less efficient in the application of resources in each *cluster*, the municipalities in *cluster* 1 get mentioned first. According to the analyzed data, the municipality of Itaperuna (RJ) is the municipality with the lowest efficiency score (0.0738), and in order to obtain the same MHDI (0.73), it would be possible to have a R$ 89.2 million revenue from current transfers and R$ 8.7 million in tax revenue unless it had the same efficiency as the *benchmark* municipality (Abadia dos Dourados/MG), based on the negative radial and clearance movements provided in the application of data envelopment analysis.

Secondly, there is the municipality of Madre de Deus (BA), with an efficiency score of 0.0884, and in order to obtain the same MHDI (0.708), it would be possible to get R$ 71 million in revenue from current transfers and R$ 7.9 million less in tax revenue if it presented the same efficiency as the *benchmark* municipality (Abadia dos Dourados/MG), also considering the negative radial and slack movements.

On the other hand, the municipalities identified as less efficient in cluster 2, the municipality of Angra dos Reis (RJ) is indicated as the municipality with the lowest efficiency score (0.1084), and for obtaining the same MHDI (0.724), it would be possible to have R$ 251.6 million in revenues from current transfers and R$ 56.6 million in tax revenues unless it had the same efficiency as the *benchmark* municipality (Carmópolis/SE). Following, there is the municipality of Madre de Deus (BA), with an efficiency score of 0.0884, and in order to obtain the same MHDI (0.708), it would be possible to get R$ 71 million in revenue from current transfers and R$ 7.9 million less in tax revenue if it presented the same efficiency as the *benchmark* municipality (Carmópolis/SE).

In short, the results of the undertaken analysis reinforce findings obtained in related studies, such as in the investigations of Postali and Nishijima (2011), Postali (2012), Givisiez and Oliveira (2011), Freitas (2013) and Froemming (2015). The identification of a relevant portion of the studied municipalities (more than 70%), that presented an efficiency score below 0.4, indicating a marked difference between the results achieved by the *benchmark* municipalities and the other municipalities not located on the efficiency frontier, consistent with the mentioned studies, as indications that the resources destined to minimize the effects of negative externalities resulting from oil extraction activities, are not generating the desired results in several municipalities.

5 CONCLUSIONS

This study aimed to evaluate which municipalities that receive oil *royalties* may be considered as reference of efficiency in the application of budgetary resources. To this end, it

evaluated the technical efficiency of 115 Brazilian municipalities using the DEA method, which occurred in two *clusters*. In the DEA model, tax revenues and average transfer revenues for the period between 2002 and 2010, have been considered as *inputs*, and the 2010 MHDI as a product.

With the application of methodological procedures, it has been made possible to indicate municipalities that may be considered as a *benchmark* for municipalities with similar characteristics, that is, present in the same *cluster*. In the first *cluster*, the municipalities of Abadia dos Dourados (MG), Porto Barreiro (PR) and Olho d'Água do Casado (AL) have been selected, from the DEA model, as units of reference, and Abadia dos Dourados (MG), due to its characteristics, can be considered as the main reference of its *cluster*, for the municipalities considered inefficient. As for the second *cluster*, the municipalities of Carmópolis (SE) and Presidente Kennedy (ES) have been indicated as reference municipalities, and Carmópolis (SE) would be the municipality appointed as the main *benchmark* for the municipalities considered inefficient in the same *cluster*.

Taking into account what has been exposed by Reis *et al*. (2005), regarding the municipalities that receive oil *royalties*, when they affirm that the management of the received resources is a decisive factor, so that they have the desired effect on the externalities generated by the oil extraction activity, the appointment of reference municipalities for localities that have a relevant share of oil *royalties* in their budget, is especially relevant for the municipalities that are not fully efficient. Thus, the in-depth study of the practices adopted by these reference municipalities can provide subsidies for public managers, on the best way to apply budgetary resources, which is an opportunity for future investigations.

Moreover, we expect that the results herein presented shall contribute in practice, so that municipalities that receive relevant amounts of oil *royalties* in their budget, obtain references for best practices in the application of resources. The investigation using the DEA method also contributes by indicating that the municipality with the highest MHDI is not necessarily the most efficient municipality, as indicated in the report of the technical efficiency analysis.

Concerns about efficiency and effectiveness in the application of resources, by municipalities that receive oil *royalties* are not only based on arguments presented during the process of political discussion about changes in the model for sharing these compensations, but also evidenced academically in the investigations mentioned in the literature review, and may also be reinforced with the results obtained in this investigation. In view of what has been presented in the data analysis, the results reinforce the need to deepen the debates and reflections on the current and proposed sharing models, with the aim that the revenues get better allocated and that the resources get applied with greater efficiency, as proposed by Maia *et al*. (2014).

In this sense, it is also expected that such initiatives will have a social impact, as they motivate the investigation of best practices in the application of resources, which may rationalize the use of public resources (especially those indicated in radial and slack movements), as well as how to subsidize new debates about the sharing model of *royalties* resources, a debate that is important for society. As Higa and Scarpin (2016) argue, the exploitation of natural resources may provide economic prosperity for municipalities, but can also lead to corruption, stagnation and poverty, a fact that can be illustrated by the alleged relationship between the receipt of *royalties* and the recent security crisis in Rio de Janeiro (Martins & Félix, 2017). This time, the choice of ways to apply these resources is what could lead the municipality and its population to one of these paths (Higa & Scarpin, 2016).

REFERENCES

Alvarenga, D. (2016). *Arrecadação com royalties do petróleo cai 25% em 2015*. Retrieved on February 13, 2016, from http://g1.globo.com/economia/noticia/2016/01/arrecadacao-com-royalties-do-petroleo-cai-25-em-2015.html

Arretche, M. (2004). Federalismo e políticas sociais no Brasil: problemas de coordenação e autonomia. *São Paulo em Perspectiva*, *18*(2), 17–26. doi: 10.1590/S0102-88392004000200003

Atlas Brasil. (2016). Atlas do Desenvolvimento Humano no Brasil 2013. Retrieved on February 10, 2016, from http://www.atlasbrasil.org.br/2013/pt/

Baumol, W. J. (1972). On taxation and the control of externalities. *The American Economic Review*, *62*(3), 307-322. doi: 10.2307/1803378

Borges, T., & Matias, M. (2011). Contabilidade Gerencial no setor público: o caso de Minas Gerais. *Contabilidade Vista & Revista*, *22*(3), 73-98.

Caçador, S. B., & Monte, E. Z. (2013). Impactos dos royalties do petróleo nos indicadores de desenvolvimento dos municípios do Espírito Santo. *Interações*, *14*(2), 267-278.

Carnicelli, L., & Postali, F. A. S. (2009). Rendas do petróleo e tributos locais: uma análise de propensity score. *Encontro Nacional de Economia*, Porto de Galinhas, PE, Brasil, 40. Retrieved from https://www.anpec.org.br/encontro/2012/inscricao/files_I/i4-fdc3484501e62a43bb676e8d282cc8f5.pdf

Casa Nova, S. P. de C., & Santos, A. dos. (2008). Aplicação da análise por envoltória de dados utilizando variáveis contábeis. *Revista de Contabilidade e Organizações*, *2*(3), 132-154.

Castro, D. P. de. (2011). *Auditoria, contabilidade e controle interno no setor público* (4a ed.). São Paulo: Atlas.

Cetin, V. R., & Bahce, S. (2016). Measuring the efficiency of health systems of OECD countries by data envelopment analysis. *Applied Economics*, *48*(37), 3497-3507.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*(6), 429-444.

Coombs, H., Hobbs, D., & Jenkins, E. (2005). *Management Accounting: Principles and Applications*. Londres: Sage.

Cooper, D. R., & Schindler, P. S. (2003). *Métodos de pesquisa em administração* (7a ed.). Porto Alegre: Bookman.

Costa, C. C. de M., Ferreira, M. A. M., Braga, M. J., & Abrantes, L. A. (2015). Fatores associados à eficiência na alocação de recursos públicos à luz do modelo de regressão quantílica. *Revista de Administração Pública*, *49*(5), 1319-1347. doi: 10.1590/0034-7612130868

Estevez-Abe, M., Iversen, T., & Soskice, D. (1999). Social protection and the formation of skills – a reinterpretation of the welfare state. *American Political Association Meeting* (pp. 1-80), Atlanta, 95. doi: 10.1093/0199247757.001.0001

Farina, E. M. Q. Q., Azevedo, P. F., & Saez, M. S. M. (1997). *Competitividade: mercado, estado e organizações*. São Paulo: Singular.

Ferreira, C. M. de C., & Gomes, A. P. (2009). *Introdução à análise envoltória de dados: teoria, modelos e aplicações*. Viçosa/MG: Editora UFV.

Freitas, A. A. B. (2013). *Rendas petrolíferas e indicadores sociais municipais: uma análise de eficiência relativa*. Dissertação de Mestrado, Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

Frezatti, F. (2007). The "economic paradigm" in management accounting: Return on equity and the use of various management accounting artifacts in a Brazilian context. *Managerial Auditing Journal*, *22*(5), 514-532. doi: 10.1108/02686900710750784

Froemming, D. S. (2015). *A distribuição das rendas do petróleo e a eficiência na gestão financeira dos municípios do estado de São Paulo*. Dissertação de Mestrado, Fundação Escola de Comércio Álvares Penteado, São Paulo.

Giacomoni, J. (2012). *Orçamento público* (16a ed.). São Paulo: Atlas.

Givisiez, G. H. N., & Oliveira, E. L. de. (2011). Royalties do petróleo e educação: análise da eficiência da alocação. *Revista Brasileira de Pós-Graduação*, *8*(1), 31-54.

Hartwick, J. M. (1977) Intergenerational equity and the investing of rents from exhaustible resources. *Americam Economic Review*, *67*(5), 972-974.

Higa, N., & Scarpin, J. E. (2016). Os impactos das receitas de royalties de recursos hídricos: um estudo comparativo entre os municípios brasileiros. *ABRACICON Saber*, *15*, 26-37.

Hirschman, A. O. (1977). A generalized linkage approach to development, with special reference to staples. *Economic Development and Cultural Change,* 25, 67-97.

Hofstede, G. (1981). Management control of public and not-for-profit activities. *Accounting, Organizations and Society*, *6*(3), 193-211. doi: 10.1016/0361-3682(81)90026-X

Horngren, C. T., Sundem, G. L., & Stratton, W. O. (2004). *Contabilidade gerencial* (12a ed.). São Paulo: Pearson.

Hotelling, H. (1931). The economics of exhaustible resources. *Journal of Political Economy*, *39*(2), 137-175.

Jones, R., & Pendlebury, M. (2010). *Public sector accounting* (6a ed.). Harlow: Pearson.

Kaur, H., & Bhalla, G. S. (2018). Evaluating the resource use efficiency of government colleges in Punjab (India): A data envelopment analysis. *International Journal of Law and Management*, *60*(3), 804-813.

Maciel, V. F., Piza, C. C. de T., & Penoff, R. N. (2009). Desigualdades regionais e bem-estar no brasil: quão eficiente tem sido a atividade tributária dos estados para a sociedade? *Planejamento e Políticas Públicas*, *33*(2), 291-318.

Maia, F. F., Terra, D. C. T., & Matta, L. G. (2014). O novo sistema de partilha dos royalties do petróleo: avaliando o debate na mídia. *Petróleo, Royalties & Região*, *11*(45), 4-7.

Martinez, A. L., & Reis, S. dos S. (2016). Impacto dos royalties do petróleo no índice de educação básica: análise do caso dos municípios capixabas. *RACE – Revista de Administração, Contabilidade e Economia da UNOESC*, *15*(2), 505-530.

Martins, F., & Félix, R. (2017). *Como a "maldição do petróleo" explica a crise de segurança no Rio de Janeiro*. Retrieved on September 25, 2019, from https://www.gazetadopovo.com.br/politica/republica/como-a-maldicao-do-petroleo-explica-a-crise-de-seguranca-no-rio-de-janeiro-90r3xzotjb9m49a9ob5h10sjt/

Martins, G. A., & Theóphilo, C. R. (2007). *Metodologia da investigação científica para ciências sociais aplicadas*. São Paulo: Atlas.

Padoveze, C. L. (2012). *Controladoria estratégica e operacional: conceitos, estrutura, aplicação* (3a ed.). São Paulo: Cengage Learning.

Pamplona, N. (2016). *ANP propõe novo cálculo dos royalties do petróleo*. Retrieved on February 13, 2016, from http://www1.folha.uol.com.br/mercado/2016/01/1727694-anp-propoe-novo-calculo-de-royalties-do-petroleo.shtml

Pamplona, N. (2017). *Rio apela ao Ministério de Minas e Energia por royalties do petróleo*. Retrieved on July 28, 2017, from http://www1.folha.uol.com.br/mercado/2017/04/1873737-rio-apela-ao-ministerio-de-minas-e-energia-por-royalties-do-petroleo.shtml

Postali, F. A. S. (2007). Efeitos da distribuição de royalties do petróleo sobre o crescimento dos municípios no Brasil. *Encontro Nacional de Economia*, Recife, 35. Retrieved from http://www.anpec.org.br/encontro2007/artigos/A07A072.pdf

Postali, F. A. S. (2012). *Rendas do petróleo e ineficiências administrativas nos municípios brasileiros*. Tese de Livre Docência, Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

Postali, F. A. S., & Nishijima, M. (2011). Distribuição das rendas do petróleo e Indicadores de Desenvolvimento Municipal no Brasil nos anos 2000. *Estudos Econômicos*, *41*(2), 463-485. doi: 10.1590/S0101-41612011000200010

Queiroz, C. R. A., & Postali, F. A. S. (2010). Royalties e arrecadação municipal : apontando ineficiências do sistema de divisão das rendas do petróleo no Brasil. *Temas de Economia Aplicada*, 12-16.

Reis, A. C., Rocha, P. S. de M. V., Ferreira, L. E. A., Correia, J. S. S., Alves, R. L., & Viana, M. (2005). Avaliação dos impactos dos royalties no desenvolvimento dos municípios arrecadadores da Bacia do Recôncavo. In *3 Congresso Brasileiro de Pesquisa e Desenvolvimento em Petróleo e Gás*. Salvador. Retrieved from http://www.portalabpg.org.br/PDPetro/3/trabalhos/IBP0561_05.pdf

Ribeiro, E. G., Teixeira, A., & Gutierrez, C. E. C. (2010). Impacto dos royalties do petróleo no PIB per capita dos municípios do estado do Espírito Santo, Brasil. *Revista Brasileira de Gestão de Negócios*, *12*(34), 25-41.

Robinson, J. A., Torvik, R., & Verdier, T. (2006). Political foundations of the resource curse.

Journal of Development Economics, 79(2), 447-468.

Rocchi, B., Landi, C., Stefani, G., Romano, S., & Cozzi, M. (2015). Escaping the resource curse in regional development: a case study on the allocation of oil royalties. *International Journal of Sustainable Development, 18*(1-2), 115-138.

Scarpin, J. E., & Slomski, V. (2007). Estudo dos fatores condicionantes do índice de desenvolvimento humano nos municípios do estado do Paraná: instrumento de controladoria para a tomada de decisões na gestão governamental. *Revista de Administração Pública*, *41*(5), 909-933. doi: 10.1590/S0034-76122007000500006

Seabra, A. A. de, Freitas, G. P. de, Polette, M., & Casillas, T. Á. D. V. (2011). A promissora província petrolífera do pré-sal. *Revista Direito GV*, *7*(1), 57-74. doi: 10.1590/S1808-24322011000100004

Sen, A. (2000). *Desenvolvimento como Liberdade*. São Paulo: Companhia das Letras.

Serra, R. V., & Fernandes, A. C. (2005). A distribuição dos royalties petrolíferos no Brasil e os riscos de sua "financeirização." *Revista de Desenvolvimento Econômico*, *7*(11), 30-38.

Serra, R. V., Terra, D., & Pontes, C. (2006). Os municípios petro-rentistas fluminenses: gênese e ameaças. *Revista Rio de Janeiro*, (18-19), 59-85.

Si, L., & Qiao, H. (2017). Performance of Financial Expenditure in China's basic science and math education: Panel data analysis based on CCR Model and BBC Model. *Eurasia Journal of Mathematics Science and Technology Education, 13*(8), 5217-5224.

Silva, J. C. B., & Lucena, A. V. (2011). Regulação social na indústria do petróleo do Brasil como fomentador do bem estar social e do desenvolvimento do país. *Revista Jurídica Cognito Juris*, *1*(3), 103-107.

Silva, G. M. da, & França, V. L. A. (2009). Petróleo, royalties e pobreza. *GeoTextos*, *5*(1), 143-164.

Souza, P. C. T., & Wilhelm, V. E. (2009). Uma introdução aos modelos DEA de eficiência técnica. *Tuiuti: Ciência e Cultura*, (42), 121-139.

Tesouro Nacional. (2016). Estados e municípios. Retrieved on March 9, 2016, from http://www3.tesouro.fazenda.gov.br/estados_municipios

Tribunal de Contas da União. (2008). *Transferências governamentais constitucionais*. Brasília: TCU.

UNDP (2019). *O que é o IDHM?* Retrieved on November 21, 2019 from https://www.br.undp.org/content/brazil/pt/home/idh0/conceitos/o-que-e-o-idhm.html