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Discussing Royalties in Brazil in Oil Price Volatility Times: A Public Management Analysis

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Abstract

Objectives/Scope: The objective of this work is to evaluate the management of revenues from royalties (and special participations fees) by the Brazilian public administration, through the construction of a dependency index to the petroleum sector, to propose new forms of management in the light of international examples and well succeeded theories of public management.

Methods, Procedures, Process: The proposed methodology of the petroleum sector dependence was done through the introduction of an indicator in the form of a composite Index that captures a region's aggregate dependence on its nonrenewable oil and gas resources. The three indicators that make up the Index are the share of export earnings from oil and gas in total export earnings; the share of revenue from petroleum in total fiscal revenue; and the oil and gas industry added value to GDP. Our approach goes beyond the application of an existing index, through an investigation of welfare indicators and further analysis of municipal public data.

Results, Observations, Conclusions: The developed index is useful as a monitoring tool for the management of revenues from royalties and special participations fees. We found that oil fees revenues growth did not generate the same proportion of welfare gains for a local population. Finally, the results drove us to conclude that there is an urgent need for a review of public management regarding the use of these revenues, given the strong dependence of Brazilian municipalities, as well as the known finiteness of natural resources.

Novel/Additive Information: The paper's original contribution is therefore through the introduction of an indicator in the form of a composite Index that accurately captures a region's aggregate dependence on its nonrenewable oil and gas resources. The novelty is the index itself, as well as its analysis and application to municipalities, which will serve as a tool for monitoring and decision making on revenue management, and the elaboration of proposals to better manage natural resources.

Introduction

This paper introduces a new index for measuring an economy's dependence on natural resources, particularly on its oil resources. As per Hailu and Kipgen (2017), there are strong arguments for reducing dependence on the extractive sector: i) declining terms of trade for commodity exports; ii) volatile commodity

prices and their impact on the economy; iii) lower rate of technological change in resource extraction activities relative to other sectors; and iv) rent-seeking behaviors, weak governance associated with resource intensive economies. Understanding how dependent municipalities are on natural resources and where this dependence originates from is helpful in crafting the right policies to move away from perpetual resource-driven development trajectories. The paper's original contribution is therefore through the introduction of an indicator in the form of a composite Index that accurately captures a region's aggregate dependence on its nonrenewable oil and gas resources.

In Brazil, given the discovery of the pre-salt, its potential and lower geological risk involved, royalties distribution among states was debated in 2008. Non-oil-producing states began a discussion of related law to the usufruct of the resources collected in function of said exploration, since they argued that the oil explored would be a national wealth and not only pertaining to the states in which the exploration took place.

Then, in 2012, President Dilma Rousseff approved law extending the pass-through of royalties to non-producing states and municipalities, from previous values of 7% and 1.25%, respectively, to 21%. In 2020, this percentage would rise to 27% of what the Union had raised. Therefore, from this change, the producing states had their collection reduced from 26.25% to 20%, and municipalities from 26.25% to 15%.

In 2015, total royalties revenues decreased by R$ 4.67 billion, along with a 35% drop in the price of the barrel, generating a 25% fall in revenues collection, when compared to 2014. Due to this circumstance, together with the reduction in royalties' percentage, Rio de Janeiro recorded a loss of R$ 900 million in its revenue collection.

From the above one can figure how royalties in Brazil are one of the most controversial issues. Along with that, one can add to an already problematic scenario the international economic crises, the oil price crises, Brazilian (and Petrobras) corruption turmoil, and the lack of investments and exploratory activity since 2013.

The distribution of oil revenues, especially of royalties, in countries with different governmental spheres, has given rise to a series of questions and discussions about the right of subnational government entities to receive oil revenues. Some of these questions concern the capacity of these entities, vis-à-vis central government competence, to manage their budgets in face of oil price uncertainties and volatilities. In addition to these factors, there are political issues, where each region seeks to guarantee to itself the largest possible revenue share, causing conflicts between the producing regions and those that are not beneficiaries by revenues transfer from exploration and production of oil and natural gas. In Brazil, there is another complicating fact: most hydrocarbon production occurs in the Campos Basin, off the coast of the Southeast Region, becoming an aggravating factor in the discussion of transfers between the spheres of government.

Methodology

In order to evaluate the management of revenues from royalties and special participation fees in Brazilian municipalities, we construct an index that takes into account how dependent a location is regarding its oil & gas industry. For such, we adapt the Extractives Dependence Index (EDI), from Hailu and Kipgen (2017) to the oil & gas industry in Brazilian municipalities. In their work, Hailu and Kipgen analyze how dependent countries are regarding their non-renewable resources in the extractive sector (oil, gas, and minerals). Their index is made up of three indicators: 1) the share of export earnings from extractives in total export earnings; 2) the share of revenue from extractives in total fiscal revenue; and 3) the extractive industry value added in GDP. They argue that their index is more suitable to capture a location's dependence because they take into account not only how significant the extractive sector is for the economy, but also how diversified the economies in these countries are. They do that by adjusting each component in the index "to capture the productive capabilities in each country to determine the presence of alternative sources of export and tax revenues as well as industrial capacity for diversification, which are important for reducing dependence on

extractive resources". We follow this methodology in our work, with a small difference: our index takes into account only the oil & gas sectors, we do not consider the minerals sector.

Hence, the Oil & Gas Dependence Index for Brazilian municipalities is derivedfrom the equation below:

$$OGDI_i = \sqrt{[EIX_i \times (1 - HTM_i)] * [Rev_i \times (1 - NIPC_i)] * [EVA_i \times (1 - MVA_i)]}$$

Where:

$OGDI_i$ = the Oil & Gas Dependence Index for municipality i

EIX_i = export revenue from oil & gas as a share of total export revenue for municipality i

HTM_i = export revenue from manufacturing as a share of Brazilian HTM exported for municipality i

Rev_i = royalties and special participation fees received as a share of total fiscal revenue for municipality i

$NIPC_i$ = total services tax revenue collected as a share of GDP for municipality i

EVA_i = oil & gas industry value added as a share of GDP for municipality i

MVA_i = per capita manufacturing value added for municipality i

We will now explain in more details each component in the equation above.

Participation of the oil & gas industry in export revenues

In order to understand if a municipality is too dependent on oil & gas revenues, we evaluate this sector's participation in total export revenues for each city considered (EIX_i). The more diversified the local economy is, the less dependent on the oil & gas sector their exports will be. Moreover, we adjust this term by multiplying it by export revenues from the high-skill manufacturing sector (machines, vehicles, and equipment), as a share of global Brazilian exports in this sector (HTM_i). With that, we are able to capture the high-skill manufacturing sector's significance in each municipality's economy.

The information about exports comes from Aliceweb, a database form the Brazilian Ministry of Industry, Trade and Services that compiles exports information for all municipalities in Brazil.

The difficulty found in utilizing exports data for Brazilian municipalities lay in the fact that many of these economies are neither large enough, so that they have exporting capability, nor much diverse. This way, for some cities, estimating both the EIX_i term and the HTM_i term in the equation was somehow problematic.

Participation of the oil & gas industry in fiscal revenues

Royalties and special participation fees are an important source of revenue for municipalities that explore oil & gas. Ideally, these revenues should be placed aside to counteract for oil & gas exploration in locations where they take place, so that future generations can accrue the benefits from these resources when they are no longer available. Instead, in many municipalities in Brazil, these revenues fund current expenditures in their annual budgets. Therefore, the more dependent a municipality is on oil & gas revenues, the more reliant on them their budget will be. This effect is captured by the Rev_i term in our equation.

In addition, we analyze whether the city governments under study rely on other sources of revenue ($NIPC_i$). Preferably, as in Hailu and Kipgen (2017), we would choose to evaluate whether the cities considered received any tax revenue from non-resource income, profits, and capital gains. The authors utilize these type of tax revenues because they are more complex to collect than property or export/import taxes, requiring, thus, stronger institutions – in particular, greater tax collection capacity.

When we look at Brazilian municipalities, however, the more complex tax collected is services tax, which is collected over any services provided within the city. These services, though, also include those related to the oil & gas industry. Hailu and Kipgen (2017) do not mention whether they were able to dissociate revenues from non-resource income, profits, and capital gains received by the extractive sector from other sectors when they built the *NIPC* term in their equation, so that the extractives sector was not considered in the adjustment term. Nevertheless, we decided to use the services tax to build our adjustment term in this part of the equation because, among the taxes collected by municipalities, it is the more complex one.

The source for royalties, special participation fees, and services tax revenues data is the Brazilian Treasury (Tesouro Nacional).

Participation of the oil & gas industry in GDP

Another way to capture how dependent an economy is on its oil & gas industry is by measuring the sector's participation in gross domestic product (GDP). In turn, if the municipality's economy is more diversified, other sectors will have a bigger weight in GDP – for instance, the manufacturing sector. Hence, we estimate the oil & gas industry value added as a share of GDP for each municipality (EVA_i), while adjusting for per capita manufacturing value added (MVA_i), which is used as a proxy for local industrial capability for the municipalities considered.

We do so by using data from the Relação Anual de Informações Sociais (RAIS) database, from the Brazilian Ministry of Labor, which is a matched employer-employee dataset that covers the universe of formal labor contracts in Brazil by sectors and subsectors in the economy. Hence, we have data regarding all labor contracts for the oil & gas sector in each municipality and, by using this information, we estimate the oil & gas sector representativeness in each municipality's GDP. The same estimation is done for the manufacturing sector.

Ideally, instead of using labor contracts to estimate each sector representativeness in GDP, we would have preferred to use their real values, that is, the oil & gas and manufacturing sectors contribution to each municipality's GDP. This data, however, was not available.

Results

Table 1 lists the Oil & Gas Dependence Index (OGDI) for year 2015, in a sample of Brazilian municipalities that receive royalties and special participation fees. The index ranges from 0 to 100, with 100being the highest dependence score.

Table 1—Oil & Gas Dependence Index (OGDI) for year 2015

	OGDI (2015)
Macaé (RJ)	29,95
São Sebastião do Passé (BA)	5,74
Campos dos Goytacazes (RJ)	5,02
Angra dos Reis (RJ)	2,99
Niteroi (RJ)	2,75
Vitória (ES)	1,64
São Sebastião (SP)	1,21
Vila Velha (ES)	0,90
Rio das Ostras (RJ)	0,54
Natal (RN)	0,37

Table 2 shows the calculations for the OGDI's components.

Table 2—OGDI's components calculations

	OGDI	EIX	HTM	Export component	REV	NIPC*	Revenue component	EVA*	MVA*	Value-added component
Macaé (RJ)	29,95	94,52	0,19	94,34	15,74	17,56	12,98	100	26,76	73,23
São Sebastião do Passé (BA)	5,74	6,34	0	6,34	7,45	12,35	6,53	79,61	0	79,61
Campos dos Goytacazes (RJ)	5,02	74,36	0	74,36	34,25	3,74	32,97	1,37	24,82	1,03
Angra dos Reis (RJ)	2,99	86,87	2,23	84,93	6,4	10,05	5,75	2,38	23,39	1,82
Niteroi (RJ)	2,75	15,65	2,75	15,22	11,38	9,93	10,25	5,18	6,11	4,86
Vitória (ES)	1,64	24,82	0	24,82	1,21	12,01	1,06	10,68	3,75	10,28
São Sebastião (SP)	1,21	69,6	0	69,6	15,14	8,8	13,81	0,15	0,59	0,15
Vila Velha (ES)	0,9	61,41	0	61,4	1,68	9,97	1,51	0,92	4,34	0,88
Rio das Ostras (RJ)	0,54	0,04	0	0,04	24,22	6,88	22,56	36,18	13,61	31,25
Natal (RN)	0,37	55,8	0	55,8	0,13	11,06	0,12	2,05	1,1	2,03

* indicates normalized values

From the ranking, one can see that Macaé, in Rio de Janeiro state (RJ), is the most dependent on its oil & gas industry from the municipalities analyzed. As explained before, Macaé tops the list because its economy is not diversified, that is, it strongly relies in the oil & gas sector to generate income and wealth for its population. Many other cities in Rio de Janeiro state are in a similar situation, such as Campos dos Goytacazes, Angra dos Reis, and Niterói.

Overall, our index does not have the same level of variation as the index developed by Hailu and Kipgen (2017). We believe this happens for a few reasons. First, the index takes into account the participation of the oil & gas industry in a municipality's exports. That is an important measure of how diverse an economy is, but many of the cities considered are small economies, that do not have exporting capability. Second, using services taxes as the adjustment term representing other sources of revenue received by municipalities may be skewing our results because the oil & gas sector is an important revenue source for the services sector in the locations considered. Hence, it is not possible to dissociate the revenues the oil & gas sector pays within the services sector in our analysis. Furthermore, we were not able to gather data regarding the oil & gas and manufacturing sectors contribution to each municipality's GDP. Instead, we use the number of active employment in each of these sectors as a proxy for their representativeness in GDP. Therefore, we may be underestimating each sector's participation in GDP. Regardless, we believe our index is a good starting point for having better measures of dependence in the oil & gas sector, since it is more comprehensive regarding the sector's impact in the whole economy.

Analyzing socioeconomic indicators in the Brazilian oil & gas cities

In Brazil, instead of being placed aside for future generations, royalties and special participation fee revenues are often used by governments with the intention to provide goods and services to the population at the time they are collected. Using these extra revenues, however, do actually improve the population's well-being? How are socioeconomic indicators evolving in the cities under study during the golden period of oil exploration in Brazil (1990-2010)? In order to answer that question, we selected five cities in our sample (Macaé, Angra dos Reis, Campos dos Goytacazes, and Niterói, in Rio de Janeiro State, and São Sebastião do Passé, in Bahia) and analyzed how some socioeconomic indicators have evolved in the period considered. We selected these cities because they are the most dependent in the oil & gas industry, according to the OGDI.

For instance, has income inequality improved in the period considered? Figure 1 shows the Gini coefficient, which measures income inequality by summarizing the dispersion of income across the entire income distribution, in our sample of cities and the states where they are located. A Gini coefficient of zero expresses perfect equality, while a Gini coefficient of 1 (or 100%) expresses maximal inequality. It would be expected that, in the period considered, revenues from oil & gas exploration would have contributed to increase the population's wellbeing, which could be translated in better income distribution. From Figure 1, one can see that was not always the case. In Niterói, income inequality has actually increased in the period (from 0.57 in 1991 to 0.59 in 2010). In Macaé, income concentration has remained very much the same. The other cities fare a bit better, but it is still noticeable how little income distribution has improved in these

cities. For Brazil, in the period, the Gini coefficient has evolved from 0.6383 in 1991, to 0.6086 in 2010, according to IBGE.

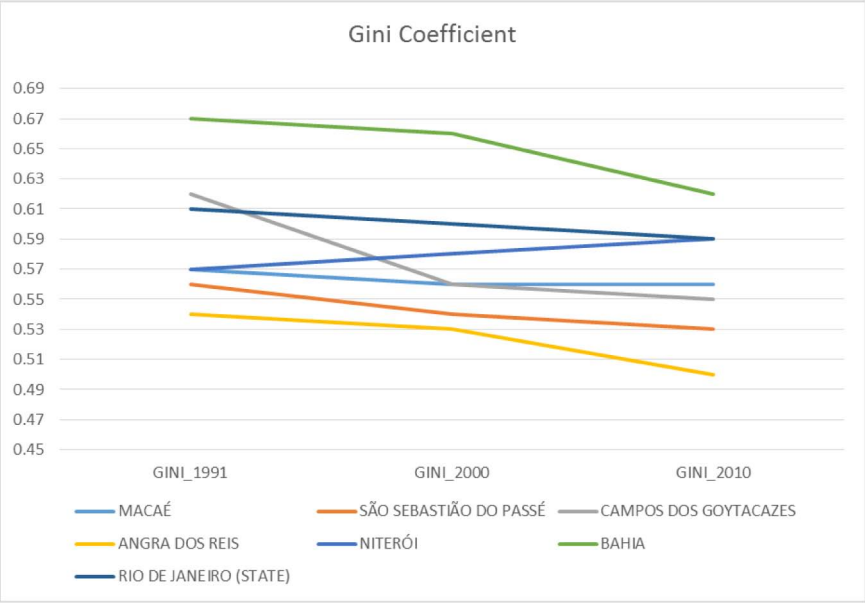

Figure 1—Gini Coefficient between 1991 and 2010 in a sample of oil & gas exploring cities. Source: IBGE.

Another indicator we can analyze in order to assess for quality of life in the cities considered is homicide rate by firearm per 100,000 inhabitants. The Latin American Social Sciences Institute (Flacso Institute) compiles data about violence in Brazil. Figure 2 shows that the only city where homicide rate by firearm has fallen, between 2012 and 2014, was Niterói. In the other cities considered, homicide rate by firearm has remained stable, indicating that violence has not improved recently in the oil & gas cities.

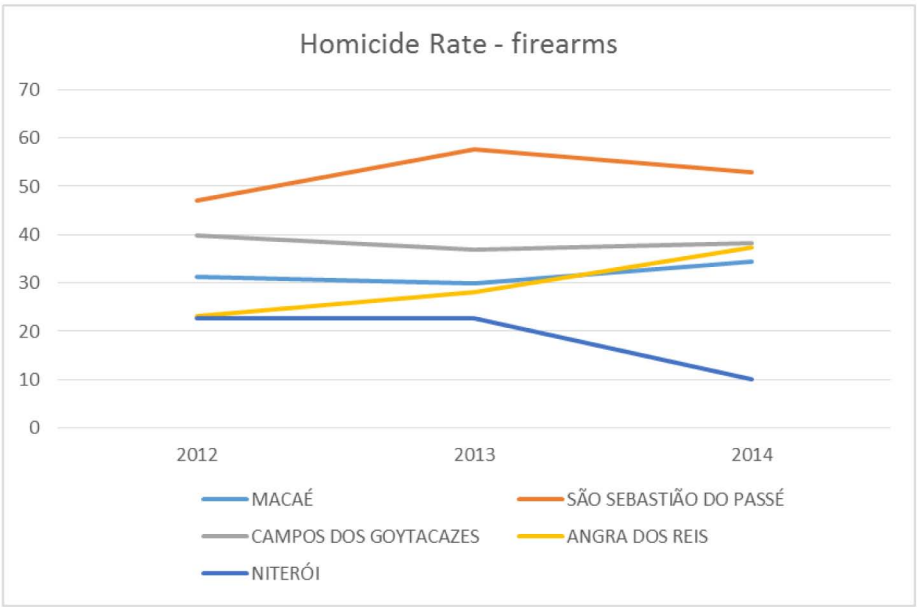

Figure 2—Homicide Rate by firearm per 100,000 inhabitants in a sample of oil & gas exploring cities. Source: Mapa da Violência, Flacso Institute.

Education quality is another indicator that we can analyze in order to see whether oil & gas resources are being well employed in the municipalities considered. In Brazil, municipalities are responsible for providing elementary and middle school education to children (grades 1 to 8). The Índice de Desenvolvimento do Ensino Básico (IDEB, an education development index based on test scores) measures educational quality in the Brazilian school system, being measured every two years and presented on a scale ranging from zero to ten, with ten being the highest score. Moreover, all Brazilian states and municipalities stablish targets for the index, so that improvements and progress can be monitored. Figure 3 and Figure 4 below show the IDEB for the cities considered and the states where they are located.

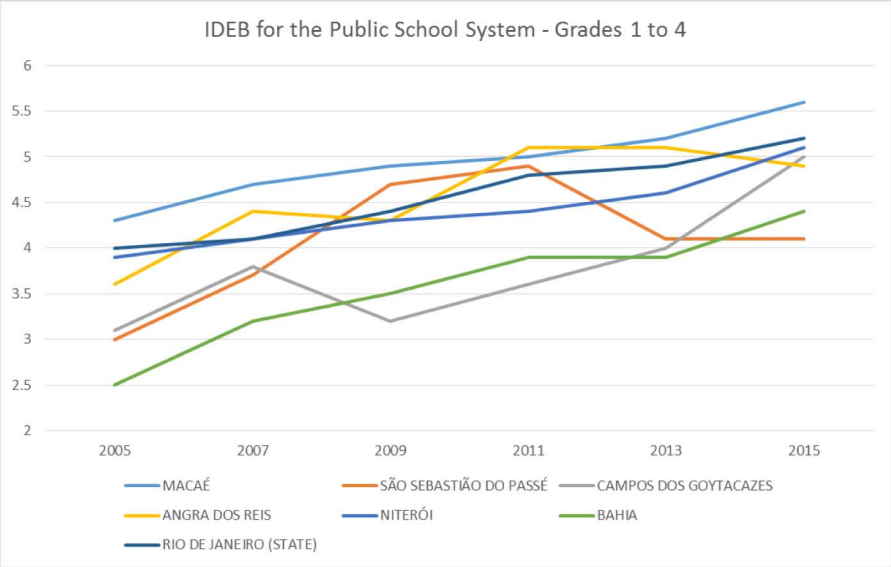

Figure 3—The IDEB index, grades 1 to 4, in a sample of oil & gas exploring cities. Source: INEP.

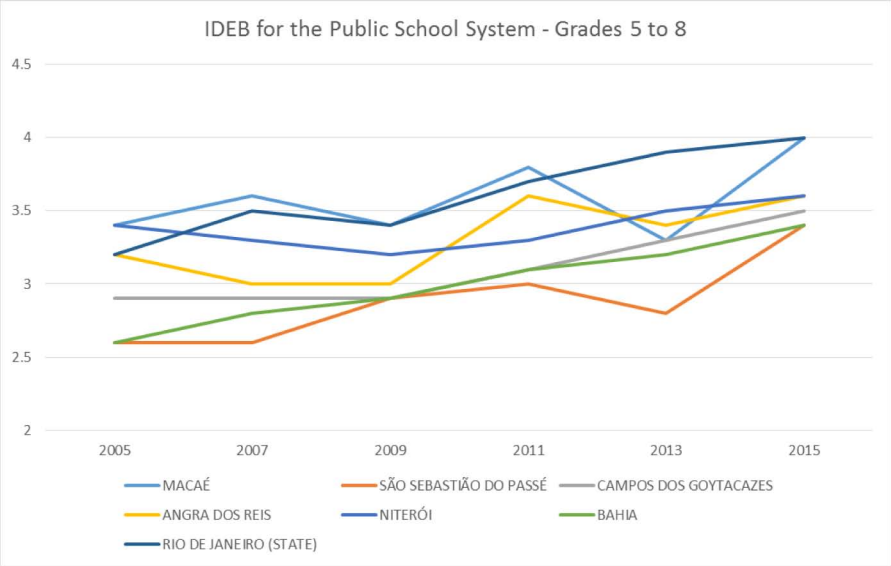

Figure 4—The IDEB index, grades 5 to 8, in a sample of oil & gas exploring cities. Source: INEP.

From the graphs, we can see that, in some cities, the IDEB has actually decreased in the time series considered, indicating that educational quality has, in fact, worsened in these locations. Moreover, many of these cities have not achieved the self-stablished targets for index improvement. In the last three years

considered, that was the case for Macaé and Niterói, in grades 1 to 4; and, in grades 5 to 8, none of the cities reached the targets in the last two years considered (see Table 3. Cells in green indicate that the annual target was reached).

Table 3—IDEB targets for the public school system.
Source: INEP.

IDEB targets for the Public School System	GRADES 1 TO 4						GRADES 5 TO 8					
	2005	2007	2009	2011	2013	2015	2005	2007	2009	2011	2013	2015
MACAÉ	4,3	4,7	4,9	5	5,2	5,6	3,4	3,6	3,4	3,8	3,3	4
SÃO SEBASTIÃO DO PASSÉ	3	3,7	4,7	4,9	4,1	4,1	2,6	2,6	2,9	3	2,8	3,4
CAMPOS DOS GOYTACAZES	3,1	3,8	3,2	3,6	4	5	2,9	2,9	2,9	3,1	3,3	3,5
ANGRA DOS REIS	3,6	4,4	4,3	5,1	5,1	4,9	3,2	3	3	3,6	3,4	3,6
NITERÓI	3,9	4,1	4,3	4,4	4,6	5,1	3,4	3,3	3,2	3,3	3,5	3,6
BAHIA	2,5	3,2	3,5	3,9	3,9	4,4	2,6	2,8	2,9	3,1	3,2	3,4
RIO DE JANEIRO (STATE)	4	4,1	4,4	4,8	4,9	5,2	3,2	3,5	3,4	3,7	3,9	4

After analyzing these socioeconomic indicators, there is evidence to conclude that oil & gas revenues are not improving the population's wellbeing in these oil 7 gas cities. Many other indicators can be studied to make this analysis even more robust, in many other cities. This will be the scope of future work.

Using the Oil & Gas Dependence Index (OGDI) as a performance management tool in Brazilian municipalities

Performance management can be used as an aiding tool to policy makers in the decision making process. According to Fryer, Antony, and Ogden (2009), based on Lemieux-Charles *et al*. (2003), "A crucial element of a performance management system is performance measurement – monitoring that shows where change is required and which will in turn produce the desired behavior that will produce improved performance". The four aspects of performance measurement are: 1) deciding what to measure; 2) how to measure it; 3) interpreting the data; and 4) communicating the results. Indicators, such as the Oil & Gas Dependence Index (OGDI), are used to measure performance. Our proposal is to use it as a tool to monitor resources dependence for the municipalities that receive oil & gas revenues. Monitoring, however, is not the target in this process; after monitoring, evaluation and policy recommendations in order to reduce dependence when it is increasing, is.

Therefore, Brazilian governments can use the OGDI in order to evaluate whether their economies are becoming too dependent in the oil & gas industry. The index can be measured annually, and policy recommendations can be implemented so that dependence can be reduced.

Conclusions

This work aimed at creating an oil & gas revenues dependence index for Brazilian municipalities. This index takes into account not only the amount of oil & gas revenue received by each municipality, but it also considers how dependent on the oil & gas industry each location's economy is. For the year 2015, we found that Macaé, in Rio de Janeiro State, is the most oil & gas dependent municipality in the country. Besides that, we evaluated a few socioeconomic indicators, and concluded that income inequality has not improved in these municipalities, albeit the oil & gas revenues they receive. Education quality and public safety also are not improving in these locations. Hence, even though these municipalities receive millions of dollars in oil & gas revenues, these resources are not translated in the provision of better services to the population. Therefore, the Oil & Gas Dependence Index (OGDI) can be used as a monitoring indicator in performance management by the city governments in these municipalities.

The OGDI formulated for this publication, however, can be improved in several ways. First, as already mentioned, many of these municipalities' economies are not very diversified. That fact *per se* already points to dependence in the oil & gas sector. For us, it interferes in the index's formulation. Moreover, the tax base in Brazilian municipalities is not very diverse. A way to address both these problems would be by formulating the index for Brazilian states, instead of municipalities. On top of that, in order to compare how well the OGDI index adjust to municipalities, it could be formulated for municipalities in another country – for instance, cities in Norway. If the same issues were experienced, the recommendation would be to adjust the index, in order to make it simpler so that it can evaluate municipalities' dependence.

Overall, this work is significant as a starting point to create an index that is more comprehensive, capturing more in depth a location's dependence in the oil & gas industry. Moreover, using this index in performance management is an important tool for governments to improve their administration and utilization of oil and gas resources.

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