THE FINANCIAL COMPENSATION AND THE DEVELOPMENT OF BRAZILIAN MUNICIPALITIES FLOODED BY HYDROELECTRIC DAMS

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Introduction

Throughout the twentieth century, belief in economic growth as the main driving force of the nation's economy has shaped and still shapes decisions about the paths chosen for the development of countries. From the standpoint of sustaining the economic growth of nations, arises a discussion on energy supply as the driving force behind such growth, both for increased production and for domestic consumption (WCD, 2000; ZARFL; LUMSDON & TOCKNER, 2015; BRASIL, 2015).

Regarding the current installed electrical capacity, more than 60% of the generation comes from hydraulic sources (BRAZIL, 2015) and the planned capacity for 2024 is 28,349 MW, with more than 22 hydroelectric dams concentrated mainly in the Midwest and the North of the country (BRAZIL, 2015, p.85). Still, according to Bermann (2007) and Moretto et al. (2012), this potential for probable expansion will have an increasing tendency to amplify socio-environmental and land use conflicts.

A controversy in the literature and in government documents concerns the discussion of the comparative advantages of electric power generation from a hydraulic matrix, considered as a renewable and efficient source from the point of view of electricity generation and the generated costs and benefits (Bortoleto 2001; 2007; Bermann, 2007; Duflo & Pande; 2007; Ansar et al. 2014).

In governmental documents and international reports, the issue of comparative advantages arises as the focus in discourses on the implementation of hydroelectric plants in Brazil (IEA, 2012; TORTAJADA, 2015). According to Bortoleto (2001), large projects are commonly explained from a discourse that, in addition to advantages at the national level, there will be local and regional gains for directly flooded localities.

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As Vainer & Araujo (1992) and Bortoleto (2001) state, the gains from large projects are directed at the national level. Thus, at the local scale, there remains only the "disruption of preexisting activities, disorderly population growth, unemployment, growth of *favelas*, social marginalization and, almost always, environmental degradation" (VAINER & ARAÚJO, 1992: 33). On the other hand, according to the PDE 2024, for example, "permanent revenue gains for the municipalities" from payment of taxes and Financial Compensation are highlighted as a socio-environmental value in favour of the construction of the hydroelectric dams (BRAZIL, 2015, p.395).

Financial Compensation (FC) stands out as one of the benefit-sharing mechanisms that are important for linking the enterprise to the locality throughout its operation time. According to Égré, Roquet & Durocher (2007), benefit-sharing instruments can link the enterprise to the development process of the municipalities through an economic contribution to the affected regions. Although this relationship is not clearly defined in the literature, according to the PDE 2024 (BRAZIL, 2015), from the point of view of municipal revenue, FC is a resource that becomes part of the municipalities' coffers, what is seen as a benefit that favours development.

From a theoretical perspective, FC can be understood as an Institution that shapes the agents' behavior regarding the use of resources. The theoretical framework of Institutional Economics can be used as a guideline to interpret and analyze such mechanism in face of the possible positive and negative results observed in the territories.

In particular, such an institution is composed of formal rules, enforcement mechanisms and informal rules (NORTH, 1990). The interface of these internal elements, according to the literature, determines if the results will be achieved according to the objectives proposed by the Institution. In the particular case of FC, depending on the arrangement of its elements, it will be possible to see positive results regarding the phenomenon of development of municipalities. At national and regional levels, different institutional arrangements may result in different observed outcomes.

In this regard, in a context of broadening the debate on the impacts of hydroelectric dams in the Brazilian territory, and in flooded municipalities, as well as the controversy about the existence of local benefits derived mainly from FC as an institution, the present work seeks to find elements that can explain the following research question: Are there evidences that FC values are associated with the development of municipalities flooded by hydroelectric dams in Brazil?

Financial Compensation

A theoretical discussion on Benefit-Sharing Mechanisms is summarized in the works of Drummond (2002), Égré & Senécal (2003), Égré; Roquet; Durocher (2007), in the works of Enriquéz (2007), Mendes (2008) and Cernea (2008). The theme of benefit-sharing mechanisms is addressed in the literature as a complementary tool to compensate communities affected by dam construction from the sharing of the ventures' financial gains, as well as a mechanism that could foster some development in the region in the long term (ÉGRÉ; ROQUET & DUROCHER, 2007).

The definition for Financial Compensation in Brazil is outlined by the National Electric Energy Agency (ANEEL) as "a legal instrument for the distribution of sums paid for the exploration of water resources for the purpose of electricity generation in Brazil" (ANEEL, 2005, p. 9). According to ANEEL (2005), the FC is "a reimbursement for the occupation of areas by hydroelectric dams and payment for the use of water for power generation". Its definition is described in article 20, paragraph 1 of the 1988 Constitution, and it was regulated by Law 7990/89.

The collected funds are distributed to the entities of the federation and can be used in health, education and public safety, as defined by ANEEL (ANEEL, 2007). However, in the legislation that defines the instrument, there are only restrictions on the use of debt payments and the payment of permanent staff (BRASIL, 1990, 2001). Therefore, FC can be considered as a resource that enters the municipality's revenue and has free allocation.

It is possible to find in the 2007 ANEEL report a generic note of potential uses of the resource. "The collected resources are distributed to the states and municipalities and can be applied in health, education and public safety (among others)" (ANEEL, 2007: p. 6). However, this information is not explicit in the previously presented legislation. Thus, what is presented is only where the FC should not be invested (as in cases of debt relief or in the payment of permanent staff), as well as in a specific use to the state and municipal Pension Funds.

Finally, according to ANEEL (2007), it is the responsibility of the Federal Court of Audit and the State Courts of Audit, and the respective State Public Prosecutor's Offices, to supervise the application of the resources.

Regarding the effectiveness of the application of resources, the current literature evaluates this effectiveness mainly from case studies that consider the possible beneficial effects on the development variables of flooded territories (Postal, Nishijima, 2000, 2013, Pizzol and Ferraz, 2010, Postali and Queiroz, 2012, Barros and de Lima, 2015), bringing negative and positive evidences of these relationships.

Financial Compensation and Development from the perspective of Institutional Economics

In order to understand the relation between Financial Compensation and development, this work uses an interpretation associated with the concepts about institutions and the respective theoretical framework. For this purpose, the definitions elaborated by Douglass North (1990) in his seminal work *Institutions, Institutional Change and Economic Performance* as well as in the article *Informal Institutions and Comparative Politics: A Research Agenda by Helmke & Levistky* (2004) are used.

Institutions are "the rules of the game in a society, or more formally, they are created constraints that shape human interactions" (NORTH, 1990, p. 3). According to the author, institutions are the key to understanding the processes of historical changes in society as well as economic performance over time.

Institutions, in general, aim to reduce uncertainties among human interactions by defining structures that guide such actions (NORTH, 1990). Yet, institutions include any

form of constraints that humans create to shape interactions, be they formal or informal constraints.

Formal rules are defined as rules that constrain human behavior and, to a certain extent, have a formal character in order to regulate elements of a more complex and hierarchical society (NORTH, 1990). Formal rules include political and legal rules, economic rules, constitutions, statutes, contracts, etc. Always focusing on the issue of transaction costs, North (1990) argues that formal rules aim to reduce transaction risks between agents. In this respect, the formal rule must be well established, well communicated and respectively well linked to enforcement mechanisms that will act as a coercion to ensure compliance with the rules. In the words of Helmke & Levitsky (2004), formal rules must be widely communicated through officially sanctioned channels.

Informal rules, in the same way as formal rules, are restrictions created on human interactions that shape the behavior of agents. As he defines (NORTH, 1990, p.4, 1991), "informal rules are created constraints as well as behavior codes and conventions". As suggested by Helmke & Levitsky (2004, p. 724), "[informal rules are] socially shared rules, usually unwritten, that are created, communicated, and enforced outside of officially sanctioned channels". For this work, we adopt the definition of Helmke & Levitsky (2004) on informal rules.

Enforcements are incentive or punishment mechanisms that ensure the compliance with established rules, based mainly on the concept of transaction cost according to North (1990). Enforcement mechanisms are fundamental elements for the functioning of institutions. Regardless if they belong to the agents themselves or are enforced by agents outside the institutions. The idea summarized by North (1990) places enforcement mechanisms as elements that set patterns of interactions that are not predicted in the rules (formal or informal) as costlier to be enforced.

As Levitsky & Murilo (2013) indicate, in an environment of weak formal rules, non-existent or poorly communicated coercive actions and high change in the institutions' operating patterns, the agents' actions have a high potential of uncertainty and therefore tend not to follow what is stipulated in the formal rules, since there is no guarantee that the expected result will be achieved, much less that the other agents will follow the rules. Also, in the analysis of the authors, it is observed that well-established enforcement mechanisms must also be fast-paced, as well as exemplary and widely reported.

In assuming that there is an interface between formal rules and informal rules, Helmke & Levitsky (2004) propose the theoretical scheme outlined in Box 1:

Box 1 – Analysis framework of the interface between formal rules, informal rules and results of the institution

Observed results x Designed results	Effective formal rule[i]	Ineffective formal rule
Convergent	Complementary Informal Rule	Substitutive Informal Rule
Divergent	Compliant/Tolerant Informal Rule	Competitive Informal Rule

Source: Adapted from Helmke & Levitsky, 2004.

The model is based on a matrix with two dimensions. The first dimension shows the results achieved by the analyzed institution. Though an evaluation of the observed results versus the designed results, it is possible to derive the convergent or divergent categories. If the observed results are the same as the planned results, the category is convergent. If the observed results are different from the planned results, the category is divergent.

In the second dimension, there is a specific discrimination in relation to the formal rules, if these can be effective or not effective, according to the presented concept. According to Helmke & Levistky (2004) effectiveness is interpreted as a well-defined formal rule, widely communicated and with well-defined and efficient enforcement mechanisms to ensure compliance with established formal rules. Finally, from the crossing of these dimensions, the interdependence quadrants of the formal rule with the informal rule will be traced.

The quadrants obtained from this crossing, according to Helmke & Levitsky (2004) are complementary, substitutive, competitive and compliant/tolerant informal rules.

- Complementary Informal Rule: this quadrant represents the situation of coexistence between formal and informal rules, in addition to the actors' perception that the established formal rules will be followed. The fact that they are complementary, as the authors indicate, means that informal rules act to maintain the stability of the institution.
- Substitutive Informal Rule: in this quadrant, it is possible to detect the existence of informal rules together with formal rules that are ineffective and incapable of guaranteeing the expected result. However, the observed result is still convergent with the expected result. It is assumed that the informal rule acts in the same sense as the formal rule, occupying the space that this formal rule was unable to guarantee, or that its enforcement mechanisms were weak to guarantee results.
- Compliant/Tolerant Informal Rule: this quadrant covers the situation of divergence between observed results and projected results. The compliant/tolerant informal rule is associated with behaviors that diverge from the obtained results and that change the formal rule in an indirect or subjective way (HELMKE & LEVITSKY, 2004: 729).

- Competitive Informal Rule: in this quadrant, informal rules are rivals to formal rules, which are characterized as weak or inadequate and their enforcement mechanisms are not able to guarantee compliance with these formal rules. Because of the divergent results, it is assumed that informal rules act contrary to formal rules by encouraging agents at certain times to violate such formal rules. Thus, the observed results diverge from the planned results.

It is proposed, henceforth, to interpret the Financial Compensation instrument as an Institution in order to identify and explore its elements according to the outlined framework of the institutional theory.

When analyzing the FC institution, ANEEL (2005) lists 40 formal rules that define aspects of the Institution. From the reading of its contents, these formal rules can be grouped into 4 groups, whose main themes are:

- FC beneficiaries and the proportionality of resource distribution;
- Forms of collection of FC sums and Responsibilities;
- Distribution of FC and responsibilities of entities;
- Itaipu royalties.

In such formal rules, it is possible to identify aspects of capitalization and allocation of resources to the municipalities. It is also possible to identify those responsible for such collection and distribution among the entities of the federation, municipalities and agencies that will benefit from such resources. However, from the moment the resource passes to the entities of the federation, specifically to the municipalities, the management and supervision of resource application become less specific. As an example, only the formal rule of article 8 of Law 7990/89 and its unfolding in Law 10195/2001 details that the resource should not be used for payment of permanent staff, debts and that can be used for the capitalization of pension funds.

According to ANEEL (2007), the enforcement issue, related to the FC oversight and its correct allocation in the municipalities, will be executed by the Courts of Audit or the Public Prosecutor's Office of each State. In spite of that, it is not clear and well-defined what applications can be prioritized in order to compensate for the possible "disturbance" or harm caused by the loss of territory for energy production purposes.

In the Federal Court of Audit's report, TCU (2008), it is not possible to find specific information on the Organization's conduct regarding the FC oversight, as well as the envisaged sanctions. It can be inferred, from this document, and its developments in the States, that the directive to be followed is strictly related to the law. Therefore, it is only possible to verify the conduct of the entities of the federation that receive the resource regarding the non-application for payroll, for debt relief and the exclusive possibility of capitalization of social security funds.

Regarding enforcement mechanisms, it was also not possible to observe formal rules that specifically outline the actions of the agents responsible for overseeing the allocation of the resource. Only the oversight system of the acquisition and distribution between the

entities is clear. Moreover, it was not possible to find, at a national scale, elements that clarify the attribution of the Federal Court of Audit and the Federal Public Prosecutor's Office specifically on the issue of the allocation of resources.

It is assumed that localities, states and regions may have different application patterns from those observed at the national level, depending on different informal rules, as well as enforcement mechanisms and even other formal rules established in the context. Thus, it is desirable to evaluate data referring to the regional scale assuming that possible characteristics that differentiate the regions can condition the results. However, this investigation at a regional scale is characterized for this work as an exploratory bias, since it was not possible to verify the specific information for each Court of Audit and the Public Prosecutor's Office of each State.

Methodology

The proposed methodology to investigate the existence of associations between sums paid through Financial Compensation and performance of development variables in the decade of 2000 to 2010 is segmented into two stages. The first step is to prospect and organize a database on the development variables and the flooded municipalities. The second step is to perform a statistical test on the mass of data in order to verify the existence of associations between FC values and performance of development variables. At this stage, data are observed at national scale and then segmented by administrative regions.

The set of analyzed data was organized from a universe of 119 hydroelectric dams in the national territory with installed capacity greater than 30MW and 600 municipalities flooded by these hydroelectric dams that received the FC. Finally, for each flooded municipality, 155 development variables were listed in the years 2000 and 2010, based on the UNDP Atlas of Human Development[ii] (PNUD, 2013).

After the data were organized, a Spearman correlation test was performed for each municipality and for each development variable, in order to find associations between paid FC values and variable performance in the decade of 2000 to 2010. Finally, it was performed a significant test for the coefficients values. These procedures was performed in the SPSS Statistics software.

The variables considered for this test are:

– Independent variables: called "importance of FC in municipal revenue": It consists of the total sum of Compensation received by the municipality over the accumulated revenue of the municipality, considering the decade from 2000 to 2010.

– Dependent variables: called development variables: They consist of the standardized variation of each of the 155 development variables considering the decade 2000-2010.

Moreover, it is important to emphasize that it was necessary to interpret the associations that were found in relation to the purpose of each variable. Such an interpretation was called "directionality of development". This is due to the fact that not always positive

or negative correlations of the Spearman test directly result in increases or decreases in aspects of the phenomenon of development in the territory. For example, for the variable "Rate of illiteracy", the higher its value, it is assumed that the lower the possibility of development of the municipality. Therefore, if there is a positive correlation between values of financial compensation and illiteracy rate, this will be interpreted as a negative result considering the development of the municipality. On the other hand, if there is a negative correlation between values of financial compensation and illiteracy rate, this result will be interpreted as positive for the development of the municipality.

Within the limits of the present work, there is no intention of discussing, in particular, the complex and multifaceted phenomenon of development. Also, for the scope of analysis, other municipalities considered as control were not evaluated, since the aim is to investigate the variation of flooded municipalities in relation to themselves through correlation analyzes. Finally, it is considered that increases or decreases in variables that measure aspects of development may increase or decrease the probability of this phenomenon occurring in the affected municipalities.

Table 1 shows how the results of the observed associations were interpreted.

Table 1 - Examples of interpretation on the Directionality of the observed results

Development variables	Expected variable performance	Observed results	Development directionality
Variable x	The more the value the better the results	Negative Spearman coefficient (The more the variation of "importance of FC in municipal revenue" the less the variation in the development variables)	Negative
Variable y	The more the value the better the results	Positive Spearman coefficient (The more the variation of "importance of FC in municipal revenue" the more the variation in the development variables)	Positive
Variable w	The more the value the worse the results	Positive Spearman coefficient (The more the variation of "importance of FC in municipal revenue" the more the variation in the development variables)	Negative
Variable z	The more the value the worse the results	Negative Spearman coefficient (The more the variation of "importance of FC in municipal revenue" the less the variation in the development variables)	Positive
Variable a	Demographic dimension variables	Positive or negative Spearman Coefficient	Neutral[iii]

Source: The author.

Results

The presented results are separate for the national and regional scales. In these results, only those associations that had, after hypothesis testing, statistically significant results were considered.

The first test was performed for all flooded municipalities (FMs) of all hydroelectric dams in Brazil; that is, at a national scale. Table 2 shows the results obtained from the Spearman Test and the respective classification of the directionality of development for the significant results at the national scale.

Table 2 - Spearman Test Results for all of Brazil

Variables 2000 - 2010[3]	N	Spearman	p-value	Dimension	Development Direcionality
Gross frequency rate (secondary school)	600	-0,130536	0,001353	Literacy	Negative
Net frequency rate (primary school)	600	-0,107922	0,008151	Literacy	Negative
Complete primary school, ratio (18-24)	600	-0,101459	0,012902	Literacy	Negative
Population with no delay in pré-primary school (6-17 years), ratio..	600	-0,101068	0,013256	Literacy	Negative
Population with no delay in primary school (6-14 years), ratio	600	-0,099504	0,014756	Literacy	Negative
Expected years of schooling (at 18 years)	600	-0,093026	0,022675	Literacy	Negative
Gross frequency rate (primary school)	600	-0,091463	0,025066	Literacy	Negative
Complete primary school ratio (16-18)	600	-0,087335	0,032445	Literacy	Negative
Complete or in the final levels of primary school, ratio (12-14 years)	600	-0,086194	0,034787	Educação	Negative
Schoolar attendance ratio (6-17 years)	600	-0,083849	0,040052	Literacy	Negative
HDI Literacy	600	-0,080657	0,048294	Literacy	Negative
Population with at leats 2 years of delay in the primary school	600	0,091013	0,025791	Literacy	Negative
Rate of people who live in house with residente without complete primary school	600	0,109026	0,007518	Literacy	Negative
Human Development Index	600	-0,090897	0,025982	Synthetic Indices	Negative
Labour force with of 1 minimum wage	600	0,083849	0,040054	Income	Negative
Poor population, ratio	600	0,087765	0,031598	Income	Negative
Poor children, ratio	600	0,099593	0,014667	Income	Negative

Ratio of vulnerable in a house with no resident with primary school.	600	0,104709	0,010272	Income	Negative
Survival probability at 40 years	600	-0,092262	0,023818	Health	Negative
Survival probability at 60 years	600	-0,080691	0,048198	Health	Negative
Population who live in a house with a higher density in a dorm, ratio	600	0,097089	0,017366	Health	Negative

Source: The author.

For the national scale, there were 21 significant correlations between the importance of FC in municipal revenue in the decade 2000 to 2010 and development variables in the areas of Education, Health, Income and Synthetic Indexes.

In general, in the national panorama, we can observe that of the 21 significant associations, all can be considered as negative in relation to the directionality of development. It is in the Education theme that we find the most relevant negative association with a Spearman coefficient of about -0.13.

In the case of the Income theme, positive associations were found between the increase in the importance of FC in the municipality's revenue and an increase in the proportion of the population that earn less than a minimum wage, also with the proportion of individuals with a household income below a minimum wage and with the rate of people living in households vulnerable to poverty and where nobody has completed basic education, the latter with Spearman coefficient of 0.10. All these positive associations point to a negative directionality of development because they may be associated with an increase in the country's inequality, in relation to income distribution, as well as the proportion of people vulnerable to poverty.

For the variables of the health category, it is also possible to observe negative directionality of the evidenced associations. There is a negative association between indicators of the probability of survival 40 and 60 as well as a positive association in the rate of population density in households. These associations can be considered negative because they can affect the quality of health in the population both in the decrease of the probability of survival and in the increase of the density of dwellers in permanent households.

In particular, for municipal HDI, there is evidence of negative directionality for development in Brazil. That is, within the national scale, it was observed that there is a negative association between FC and municipal HDI performance. The greater the importance of FC in municipal revenue, the lower the HDIm variation in municipalities flooded by hydroelectric dams.

Segregating the data by regions, it is possible to observe the following associations, as described in Table 3:

Table 3 - Spearman test results for Brazil's regions

Variables 2000 - 2010	N	Spearman	p-value	Dimension	Development Directionality
Midwest					
Theil index	67	-0,297617	0,014447	Income	Positive
Human Development Index - Income	67	-0,262968	0,031557	Synthetic Indices	Negative
Northeast					
Illiteracy rate (25 years or more)	48	-0,320677	0,026269	Literacy	Positive
Attendance rate (18-24 years)	48	-0,310039	0,031989	Literacy	Negative
Illiteracy rate (18 years or more)	48	-0,309170	0,032498	Literacy	Positive
Illiteracy rate (15 years or more)	48	-0,308193	0,033079	Literacy	Positive
Ratio of population with piped water supply in the house	48	0,307976	0,033210	Health	Positive
North					
Population ages 15-17	26	-0,426325	0,029872	Demography	Neutral
Population ages 16-18	26	-0,420585	0,032398	Demography	Neutral
Female Population ages 15-19	26	-0,409643	0,037686	Demography	Neutral
Schoolar attendance ratio (15-17 years)	26	-0,409915	0,037547	Literacy	Negative
Schoolar attendance ratio (6-17)	26	-0,399658	0,043091	Literacy	Negative
Household income per capita for the 10% richest	26	-0,544615	0,004019	Income	Positive
GINI index	26	-0,527540	0,005613	Income	Positive
Mean household income percapita for the 20% richest	26	-0,517265	0,006808	Income	Positive
Percentage of total income appropriated by the 10% of the population with the highest per capita household income	26	-0,483761	0,012283	Income	Positive
Activity rate of people (age 10 years or more)	26	-0,451624	0,020557	Income	Positive
Population in active age (ages 15-17)	26	-0,422294	0,031629	Income	Neutral
Percentage of total income appropriated by the 20% of the population with the highest per capita household income	26	-0,416068	0,034504	Income	Positive
Theil Index	26	-0,407388	0,038857	Income	Positive

Theil Indexe (work revenue)	26	-0,395759	0,045361	Income	Positive
Percentage of total income appropriated by the 80% of the population with the lowest per capita household income	26	0,416068	0,034504	Income	Positive
Total employed with complete secondary school	26	0,432479	0,027343	Income	Positive
Percentage of total income appropriated by the 60% of the population with the lowest per capita household income	26	0,556239	0,003169	Income	Positive
Southeast					
Gross frequency rate secondary school	310	-0,189869	0,000779	Literacy	Negative
Populatio with secondary chool complete, ratio (ages 18-24)	310	-0,185595	0,001027	Literacy	Negative
Human Development Index – Literacy sub index	310	-0,183522	0,001171	Literacy	Negative
Population in the primary school with no delay (ages 6-14).	310	-0,175994	0,001868	Literacy	Negative
Ratio of population with primary school completed (ages 16-18)	310	-0,166694	0,003243	Literacy	Negative
Population with complete or in the final levels of pré-primary school, ratio (06-17 years)	310	-0,165149	0,003545	Literacy	Negative
Complete or in the final levels of primary school, ratio (12-14 years)	310	-0,164384	0,003704	Literacy	Negative
Expected years of schooling (18 years)	310	-0,161645	0,004326	Literacy	Negative
Net frequency rate pré-primary	310	-0,154847	0,006298	Literacy	Negative
Gross frequency rate pré-primary	310	-0,130294	0,021757	Literacy	Negative
Net frequency rate primary school	310	-0,122501	0,031063	Literacy	Negative
Illiteracy rate (15 years or more)	310	0,111585	0,049662	Literacy	Negative
Illiteracy rate (18 years or more)	310	0,112754	0,047307	Literacy	Negative
Population with at leats 2 years of delay in the primary school (ages 6-17)	310	0,178166	0,001636	Literacy	Negative
Rate of people who live in house with residente without complete primary school	310	0,190130	0,000766	Liteary	Negative
Human Development Index - Literacy	310	-0,181763	0,001308	Synthetic Indices	Negative

Human Development Index	310	-0,172584	0,002294	Synthetic Indices	Negative
Employed in the service sector	310	-0,157623	0,005412	Income	Negative
Mean household per capita income of poverty vulnerable population	310	-0,130452	0,021596	Income	Negative
Ratio of emplyed without regular documentaiton (18 years or more)	310	-0,114059	0,044786	Income	Negative
Ratio of population in poverty	310	0,157753	0,005373	Income	Negative
% of people vulnerable to poverty with no primary school completed	310	0,167105	0,003167	Income	Negative
Ratio of population with eletric energy supply	310	-0,173162	0,002216	Health	Negative
Ratio of population with piped water supply and regular bathroom in the house	310	-0,159527	0,004871	Health	Negative
Ratio of population with piped water supply in the house	310	-0,124433	0,028485	Health	Negative
Survivor probabilty at 60 years	310	-0,113887	0,045112	Health	Negative
Survivor probabilty at 60 years	310	-0,111662	0,049505	Health	Negative
Under-five mmortality rete	310	0,161094	0,004462	Health	Negative
Under-one mortality rate	310	0,169096	0,002820	Health	Negative
South					
Population (ages 11-13)	149	-0,198410	0,015280	Demography	Neutral
Population (ages 11-14)	149	-0,186620	0,022675	Demography	Neutral
Female Population (ages 10-14)	149	-0,176754	0,031053	Demography	Neutral
Females (ages 12-14)	149	-0,170600	0,037509	Demography	Neutral
Population (ages 12-14)	149	-0,166290	0,042676	Demography	Neutral
Male Population (10-14)	149	-0,164446	0,045061	Demography	Neutral
Ratio of population in the school (ages 4-6)	149	0,206570	0,011485	Litearcy	Positive
Active Population (ages 10-14)	149	-0,185203	0,023743	Income	Negative

Source: The author.

Starting with the Midwest region, only two variables were identified with significant association, namely: Theil work and HDI income fraction.

In the case of the Theil work index, which measures the inequality in the distribution of employed individuals who are 18 years of age or older, according to their work income, the higher the index, the greater the inequality among these individuals. In the FMs of the Midwest, it is possible to observe a negative association with a Spearman coefficient of -0.297. This means, for this work, a positive directionality in the development of these municipalities; that is, the higher the FC, the less unequal the municipalities are in relation to the work income of individuals over 18 years of age.

On the other hand, the HDI income fraction has a negative association with FC gains. The higher the FC sum received by the municipality in the decade, the lower the variation of the HDI Income index. We can consider this evidence as a negative directionality, insofar as the income fraction is mainly composed of the per capita income index. Although the inequality index has a positive directionality, the synthetic index, which also considers qualitative factors of income, was characterized as negative directionality.

In the case of the Northeast region, there are five significant associations, mainly concentrated in the Education field. Illiteracy rates are negatively associated with FC gains. This can be considered as positive directionality since the decrease of this rate means the decrease of illiterates in the municipalities. The municipalities that received FC sums had greater positive variations in these indexes. Contrary to that, the rate of the population between 18 and 24 years old that was attending school stands out, which is associated negatively to FC gains. At the outset, within the limits of the analysis of this methodology, it is possible to characterize this association as negative for development, since it is understood that fewer individuals are attending school.

As for the health theme, only one index was evidenced with a positive association and a Spearman coefficient of 0.307. The "Water coverage rate" index indicates the proportion of people living in households with piped water. This positive association can be considered as a positive directionality because the increase in FC gains is positively associated with the increase of this rate in the decade.

In the North region, 17 significant correlations were found in the Demography, Income and Education themes. As previously observed, the smaller the sample universe, the smaller the number of possible correlations; however, these should have higher Spearman coefficients. In the case of demographic indexes, we can observe coefficients above 0.4. As previously established, demographic indexes are considered for this work as indexes with neutral directionality in relation to development.

In the case of the Education indexes, it was possible to observe negative associations between the increase of the importance of FC in the revenue of the FMs and the variation of school attendance of the population from 6 to 17 years old; that is, the greater the FC variation, the lower the school attendance of the population from that age group.

The most prominent result is in the Income dimension, related to the reduction of income inequalities. There is a negative correlation with the GINI, THEIL and THEIL trab index, pointing to smaller variations due to higher FC values in the municipalities. It is important to note that, associated to this result of the coefficients that measure income inequality, there is a positive correlation between the increase in FC values and increase in the variations of income indexes associated with low-income populations and negati-

vely for high-income populations. That is, the result on inequality can be interpreted as a significant result in the flooded municipalities of the northern region, since the GINI, THEIL indexes decreased more where there are higher FC values together with a possible de facto income distribution, observing the income increase of the poorest populations and income decrease of the richest populations.

In the Southeast region, there were 29 significant associations. None of these exceeded a Spearman coefficient of 0.2, either positively or negatively. All associations were considered with negative directionality for development in all subjects. But what draws attention, and which can represent in a general way the results, is in the correlation with the municipal HDI and HDI Education synthetic indexes. These had negative correlations due to the increase in FC in the total revenue of the municipalities.

In the South region, as shown, there were eight significant associations in the areas of Demography, Education and Income. Considering the demography theme as neutral directionality for development, there are only two significant associations, namely the percentage of the population of 4 to 6 years of age attending school, whose association and directionality of development are positive, and the population of active age, in the range of 10 to 14 years of age, considered as negative directionality and respectively with Spearman coefficients 0.20 and -0.18.

It is important to note that the Spearman coefficients, at the national scale, have low values for the related significant associations. This is due to the complexity of elements that are present in the territory and consequently are also captured by the development variables. This is not a controlled study, but a study of the real territory and its many facets.

Even so, considering the complexity of the territory, it was possible to identify significant correlations for all of Brazil. Given the complexity of the elements acting in the territory, the presence of significant correlations can demonstrate that there is a relevant influence of the FC on the performance of development variables.

In the case of regional segregation, the Spearman coefficient values are higher. As at the national level, regions also have complex features that are also captured by development variables. However, for these regions, it is possible to be said that the associations between FC and performance of development variables are more clearly present.

Interpretation of results from the perspective of Institutions

From the results obtained through the correlation test and the respective interpretation of the directionality of development, it is possible to detect whether the Financial Compensation institution may be aligned with the development purpose discussed above. For this respect, the previously outlined analysis model, consisting of the definitions of North (1990) and Helmke & Levistky (2004), is used to interpret the results. In this model, categories are outlined that relate the interface between formal and informal rules in face of the observed results of the analyzed institutions. This categorization, according to the authors, can demonstrate the importance of the interface between the formal and informal rules as determining factors for achieving the expected results of the institution.

Table 4 presents the summary of the results for each analyzed category, as well as the framing of these within the predefined categories in the analysis model.

Table 4 - Summary of Spearman test results and classification of the results in face of the Framework of analysis

Selected Criteria	Number of associations	Positive associations	Negative associations	Neutral associations	Results frame
National scale	21	0	21	0	Divergent
Midwest Region	2	1	1	0	Divergent
Northeast Region	5	4	1	0	Convergent
Northe Region	17	10	4	3	Convergent
Southeast Region	29	0	29	0	Divergent
South Region	8	1	1	6	Divergent

At first sight, at a national scale, it was not possible to observe positive associations between changes in the importance of FC variable and development variables. On the contrary, only negative associations were evidenced, indicating that the greater the importance of FC in the municipalities, the lower the variations in the indexes.

However, from a national perspective, it is possible to consider that there is a great deal of discrepancy between the development of municipalities with different regional realities. Considering the possibility that the formal rules are not well defined and that the enforcement mechanisms may vary according to the region in which the municipalities are, data has been analyzed regionally.

By following the regional analysis, it could be observed that there are indeed divergences between the results by regions. The North and Northeast regions, which presented associations with positive directionalities, and the South region, which had significant changes in the demography theme, considered neutral for this work, stand out. In particular for the North region, positive directionality in the Income theme (focusing on inequality variables), and for the Northeast region, a positive directionality for the Education theme.

When interpreting from the perspective of Institutional Economics, it is assumed that the formal rule of the FC institution is not effective in what concerns the application of the obtained resources, as previously described. Furthermore, enforcement mechanisms are also not well established according to formal rules. Therefore, it is possible to frame the Financial Compensation institution in the second column of the analysis model of Box 1 (non-effective informal rules).

At the national level, divergent results were observed in relation to the results proposed by the FC institution. Assuming that the formal rule is not effective, as well as its enforcement mechanisms are also not active, in presenting a divergent result, it is assumed that the informal rule that acts is also characterized as competitive; that is, shifting the obtained resources for other purposes.

At the regional level, other results could be observed. As it was an exploratory investigation, it was not possible to verify in detail the establishment of each State's enforcement mechanisms. However, it is assumed that even considering the possibility of each State acting in a different way, the established formal rule is of a federal character, therefore it is valid for all States. This is attributed to the inference that each state's enforcement mechanisms are also conditioned by a non-effective formal rule. That is, we can infer that even for the regional scale, the analysis is situated in the dimension of the non-effective formal rule.

When observing convergent results in the North and Northeast regions, having framed the formal rule in the non-effective quadrant, it can be inferred that informal rules may be acting in the substitutive sense; that is, taking space from the non-effective formal rule and driving resources to an expected result, defined by the Institution.

This is an inference to be tested in future work in order to really understand the relationship between the formal, informal rules and enforcement mechanisms present in these regions. However, it was possible to show, within the limits established for this work, that these regions have positive results regarding FC values and performance of development variables.

Conclusion

From the interpretation of financial compensation as an institution, it was assumed that the composition of formal rules and enforcement mechanisms can define the scope of expected results for the Institution. In this respect, when analyzing the composition of the Institution at the national level, it was possible to observe that it does not have clear formal rules regarding the application of resources, as well as specific definitions for the proper functioning of enforcement mechanisms specifically conducted by the Courts of Audit and the Federal and State Public Prosecutor's Offices.

At the national level, it was possible to show that there are negative associations between FC values paid to directly flooded municipalities and performance in development variables. That is, at the national level, municipalities that received FC sums had smaller variations in development variables. This evidence was interpreted as negative in relation to the phenomenon of development and it can be inferred that this result is associated with an institution whose formal rules are not clear and the enforcement mechanisms are not acting; moreover, according to the theory, the informal rules present in the context act in a different respect from the expected by the previously established objectives of the Institution.

At the regional level, the North and Northeast regions presented associations considered as positive, especially regarding the Education and Income Inequality themes. For this result, exploratory in nature, it can be inferred that the regions have characteristics related to the informal rules that possibly contribute to observe positive results. From the perspective of Institutional Economics, the formal rule can still be characterized as non-effective, since it is the same from the national level. Although enforcement mechanisms can work in a variety of ways for each region, they are

still conditioned by a non-effective, non-detailed formal rule on the application of resources.

It remains, therefore, to infer that in the case of regional evidence, informal rules can act in a substitutive way, and therefore guarantee the expected result of the Institution. However, this inference must be addressed in future works, especially in the North and Northeast regions.

Finally, it is possible to see the interface between formal, informal rules and enforcement mechanisms as an analytical model that allows interpreting the observed results. The discussion that arises, which is corroborated by the literature, is in understanding that positive results of an institution must be linked to well-established formal rules and clear and precise enforcement mechanisms, as well as the understanding of informal rules, can also be decisive in the territory. As noted, even in the absence of effective formal rules, the set of informal rules can replace such non-effective rules and guarantee the expected result. This point can demonstrate that the set of informal rules of a given region must also be considered as a planning element capable of guaranteeing the development of localities flooded by hydroelectric dams.

In this respect, the detailed understanding of the flooded territory, or which has flooding potential in future projects, as well as its set of formal and informal rules, can be taken as a fundamental strategy to increase the effectiveness of the application of Financial Compensation values. According to the results of this study, in an environment where formal rules of application are not directly defined, the rules that already operate in the municipalities seem to have a strong influence on the way resources will be applied. From the point of view of public management, it is therefore plausible to consider that a prior and detailed evaluation of this set of formal and informal rules, as well as the definition of specific strategies for application of resources, should be developed or improved systematically before and during the implementation of major infrastructure works, so that, finally, it is possible to observe real gains in the development of flooded municipalities.

Submitted: 27/07/2016
Accepted: 30/07/2017
http://dx.doi.org/10.1590/1809-4422asoc0169r1v2042017

Notes

i The term effectiveness, according to the authors is defined as: "Effective formal institutions actually constrain or enable political actors' choices" (HELMKE & LEVITSKY, 2004, p. 728)

ii Available on http://www.pnud.org.br/IDH/Default.aspx?indiceAccordion=1&li=li_AtlasMunicipios , access in July 2017.

iii Demographic variables are considered for this work as neutral directionality because they depend on other factors for relative analysis of development, be it positive or negative.

iv All these variables were traduce by the author due to the lack of english information on the official website of the Brazilian Institute of Geograpfy an Statistics accessed in December 2017.

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Submitted: 27/07/2016
Accepted: 30/07/2017
http://dx.doi.org/10.1590/1809-4422asoc0169r1v2042017

THE FINANCIAL COMPENSATION AND THE DEVELOPMENT OF BRAZILIAN MUNICIPALITIES FLOODED BY HYDROELECTRIC DAMS

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***Abstract*:** Enhancing the Development of localities affected by hydroelectric dams have been discussed in technical and academic literature recently. One of the legal instruments seen as a promoter of local development is the Financial Compensation (CF in Portuguese). In this context, a question that arises is if CF is associated to the development of Brazilian municipalities flooded by hydroelectric dams. Based on a correlation analysis between the values obtained by the financial compensation and the performance of 155 human development variables, it was verified that, during 2000-2010, for 600 flooded municipalities, there were negatives associations between values of CF and values of development variables. When segregating the data per region, only the North and Northeast regions showed positive associations, which seems to be related to a different institutional environment, in relation to the application of municipal resources. The CF is an important instrument that needs to be improved regarding its formal rules and enforcements, from an institutional perspective. Nevertheless, it can be inferred that informal rules as also regional dynamics can determine the development of territories due to absence of effective formal rules.

***Keywords*:** Compensation, Development, flooded municipalities, institutions

***Resumo*:** Possíveis melhoras no desenvolvimento de localidades afetadas por hidrelétricas tem sido, recentemente, um tema debatido na literatura técnica e acadêmica. Um dos mecanismos legais visto como promotor de desenvolvimento local é a Compensação Financeira (CF). Nesse contexto, a pergunta que se coloca é se a CF está associada ao desenvolvimento dos municípios brasileiros alagados pelas hidrelétricas. A partir de uma análise de correlação entre os valores auferidos pela compensação financeira e os desempenhos de 155 variáveis de desenvolvimento humano, verificou-se que, ao longo de 2000-2010, para 600 municípios alagados, há associações negativas entre valores pagos pela CF e variáveis de desenvolvimento. Ao segregar os dados, apenas as regiões Norte e Nordeste apresentaram associações positivas, o que parece estar relacionado a um ambiente institucional diferenciado, em relação a aplicação de recursos municipais. A CF é um importante mecanismo

que necessita ser aprimorado do ponto de vista das regras formais e instrumentos de *enforcements,* numa perspectiva Institucional. Ainda, é possível inferir que as regras informais e a dinâmica regional também podem determinar o desenvolvimento dos territórios mesmo na ausência de regras formais efetivas.

***Palavras-chave*:** Compensação Financeira, Desenvolvimento, Municípios Alagados, Instituições

***Resumen*:** Las posibles mejoras en el desarrollo de localidades afectadas por hidroeléctricas han sido un tema debatido en la literatura técnica y académica. Uno de los instrumentos legales visto como promotor de desarrollo local es la Compensación Financiera (CF). La pregunta que se plantea es si la CF está asociada al desarrollo de los municipios brasileños inundados por hidroeléctricas. A partir de un análisis de correlación entre los valores obtenidos por la compensación financiera y los resultados de 155 variables de desarrollo humano, se verificó que, a lo largo de 2000-2010, para 600 municipios inundados, hay asociaciones negativas entre valores pagados por la CF y variables de desarrollo. Sin embargo, regionalmente, Norte y Nordeste presentaron asociaciones positivas, lo que parece estar relacionado a un ambiente institucional diferenciado, en relación a la aplicación de recursos municipales. La CF es un importante instrumento que necesita ser mejorado desde el punto de vista de las reglas formales e mecanismos de *enforcements*, en una perspectiva institucional. Además, es posible inferir que las reglas informales y la dinámica regional pueden determinar el desarrollo de los territorios mismo sin la presencia de reglas formales efectivas.

Palabras clave: Compensación, Desarrollo, municipios inundados, instituciones