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*Public Financial Management Policies: Issues of Taxation, Budgeting  
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**The "Ecological ICMS" as an economic incentive for municipal  
environmental management**

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## Abstract

The "Tax on the Movement of Goods and Services (ICMS)" is the most important State Value Added Tax in Brazil. According with the Brazilian Federal Constitution (1988), each State Government has autonomy to define specific criteria for sharing ICMS tax revenues to their municipalities. Using this possibility, seventeen Brazilian States introduced different environmental criteria in the definition of the distribution to the municipalities of the resources collected as ICMS, named Ecological ICMS (ICMS-E). Therefore, municipalities presenting better environmental performance receive more resources, considering parameters such as protected areas for conservation, Indigenous lands, sanitation and solid waste disposal management. The idea of this policy scheme is to encourage municipalities to improve their own environmental performance in order to obtain a higher transfer of ICMS. In theory, this should lead to higher local spending on environmental management and protection. However, the resources received by the ICMS-E are not tied to the need for environmental expenditures, and part of the municipality's environmental performance score is independent of its direct action, such as when there are state or federal Conservation Units in its territory. Since there is no mechanism that ensures that the largest transfer of ICMS-E will mean greater effort for local environmental management, it is possible that the policy does not reach its main objective (to improve environmental conditions in the municipality). This research aims precisely to empirically verify if the ICMS-E can stimulate the adoption of sustainable practices by the municipalities, measured by the volume of environmental expenditures spent by the local government. An analysis was made comparing the environmental expenditures of the municipalities and the volume received from the ICMS-E, in absolute terms and in proportion to their total budget revenue. Two levels of comparison were made: (i) between municipalities of the same state, and (ii) between municipalities of states that have ICMS-E and those that do not. The analysis contemplated the period 2012-2016 and used municipal budgetary data available in the Brazilian Public Sector Accounting and Tax Information System, and in the State Departments of Environment and Finance. The positive correlation between the resources received by ICMS-E and environmental expenditure was proven, and it shows that economic instruments can play a relevant role in making public management more sustainable, and it is necessary to discuss their replication in other fiscal areas. The case of the Ecological ICMS in Brazil shows the potential role that economic instruments can play as a coordination mechanism between different federative spheres in environmental management and, possibly, in other areas of public policy.

## Keywords

Ecological ICMS, financial policy, environmental policy, federative coordination, Brazil



## Introduction

The Ecological ICMS (ICMS-E, where ICMS means Tax for the Circulation of Goods and Ecological Services, a value added tax in Brazil), also called Green ICMS, is a public regulatory policy developed by some Brazilian states with the aim of stimulating and rewarding municipalities that maintain adequate environmental practices in their territories by state legislation. This is not a new tax, but the establishment of environmental performance criteria to redistribute the share of resources to be transferred to municipalities (ICMS quota).

Municipal resources obtained through the transfer of the ICMS-E are not necessarily allocated to environmental expenditures and can be used for other purposes, such as supplementing municipal accounts and implementing social policies. This is due to the untying of expenses, characteristic of tax transfers, in which municipalities are free to allocate resources according to their priorities and interests.

Given its characteristics, it is understood that the ICMS-E is used as a coordination mechanism between the interests of the states and the actions of municipal entities. In this sense, it would be able to generate a positive competition among municipalities that, in order to obtain larger funds from state transfers, try to meet environmental criteria, which would theoretically increase their spending on the theme.

Thus, this study seeks to identify the relationship between ICMS-E received and municipal environmental expenditure. The main variable to be explained is the percentage of the expenses settled with the function "Environmental Management" on the total liquidated expenses of the municipalities. Expenditures paid for this function relate to the capacity of a municipality to establish environmental management systems, and do not include the costs of sanitation, urban cleaning and garbage collection included in other government functions.

The article is divided into four sections besides this introduction. The first discusses the ICMS-E as a public policy capable of promoting federative coordination between states and municipalities. The second section presents the research methodology, based on statistical



analysis using linear regression. The third section exposes and analyzes the results of this study. Finally, the main conclusions are presented in the fourth section.

## Coordination of public policies and Ecological ICMS in Brazil

Brazil is a federation, where Union, States and Municipalities share national sovereignty, at the same time as they are autonomous. With this autonomy, specified in the constitutional attributions, the entities can define their own legislations (as long as they see about their peculiarities), self-government, manage, have the ability to define about their public policies and finances.

Among the public policies that must be carried out jointly by federal entities are environmental policies (Articles 23 and 24 of the Federal Constitution of 1988). It is considered the concurrence of the competence of the three federative entities in this appropriate matter, because the environment is, at the same time, in the global and local space. Shared competence, however, entails the risk that one pass to the other the assignment that was due to him and no one will solve the problem. In addition, overlapping or contradictory actions related to environmental protection may occur (Castro & Young, 2017).

To avoid such problems, different mechanisms of coordination between the actions of federative entities can be used. Coordination refers to the orderly, coherent and methodical disposition of a given system, and can be defined as managing interdependencies between activities (Malone & Crowston, 1994). The study of coordination requires asking what types of interdependence exist between activities, and how such interdependencies and activities can be managed. Thus, federal coordination refers to the management of interdependent activities between the various levels of government and their public policies.

Among the interdependencies between federative entities, it is possible to mention the fiscal question. Due to the inequalities, existing in any federation but rather accentuated in Brazil with respect to the economic environment, compensatory measures were created, such as tax transfers that aim to redistribute resources among federative entities (Maciel, Piza, Penoff,



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2009). This proposal is anchored in the principle of solidarity, which imposes the sharing of wealth among the entities with the intention of strengthening their political autonomy. A study by FIRJAN (2017) points out that the Municipalities, for the most part, still depend on onlending from other entities to obtain current revenues. According to the same study, only 136 municipalities, out of a total of 4,544 analyzed in the FIRJAN Tax Management Index, managed to obtain more than 40% of their revenues from their own resources. In other words, the Municipalities depend on the resources transferred by the Union and the states to carry out their public policies. The States and the Union, on the other hand, depend on the Municipalities for various policies to reach citizens, including environmental ones. However, when dealing with transfers, there is no obligation for Municipalities to use these resources in the interests of other federal entities.

The federal coordination can be obtained by different strategies based on cooperation and competition between the entities, and the most appropriate would be to achieve a balance between them (Abrucio, 2005).

Cooperation can be stimulated through legislation that obliges actors to share decisions and tasks, fostering partnerships to solve public problems. However, for this to happen, it is necessary to build a political culture based on mutual respect and negotiation at the intergovernmental level, an incipient thing in the country (Abrucio, 2005).

Competition can also be used to achieve coordination between different levels of government. First, because of the importance of mutual controls as an instrument against mastery of one level of government over others. In addition, federative competition can favor the search for innovation and better performance of local management, since voters can compare rulers. However, there are problems arising from excessive competition, such as the fiscal war, which affects solidarity between entities (Abrucio, 2005).

It is important to emphasize that access to information and the ability to enforce contracts are relevant to the strategies mentioned here, but also to other mechanisms for achieving coordination proposed by authors such as Mintzberg (2008) who recommends the use of mutual adjustment , hierarchical control and standardization; and Bouckaert, Peters and Verhoest



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(2010) who suggest market-based mechanisms; hierarchy and network agreements. The hierarchical mechanism, pointed out by the authors, deserves to be highlighted, since in the literature there is a discussion about the need for leadership to stimulate coordination, with the objective of organizing interdependent activities. However, Metcalfe (1996) points out that acceptance of leadership may not be effective in regimes characterized by large organizational autonomy. In such cases, organizations would develop a capacity for coordination among themselves in response to increasing interdependence. The latter author admits, however, that a highly coordinated government is difficult to achieve, since the state contains within its structure actors with very heterogeneous interests.

In Brazil, inequalities in the tax system impel agreements and partnerships between government spheres, since it is difficult for the entities to have sufficient funds to carry out public policies alone. On the other hand, states and especially the Union fulfill the role of leaders in the search for coordination between the different federative entities, mainly because of their greater capacity of collection, monetary transfers and financing, which ends up subjugating other governmental units (Arretche, 2006). Leadership is generally used to foster competition in order to manage the interdependencies between activities to achieve common goals, for example, by establishing criteria for the redistribution of money transfers, as in ICMS-E .

The Tax on the Circulation of Goods and Services is a state tax regulated by articles 155 and 158 of the Federal Constitution of 1988, which determines that 25% of the total amount of ICMS collected by the state must be transferred to its municipalities. Of this share belonging to the municipalities, three quarters must be distributed according to the proportion relative to the value added in the operations of circulation of goods and services rendered in the territory. A fourth must be distributed according to state law, which has autonomy to define the specific criteria to transfer the resource.

Taking advantage of this possibility, some states included environmental criteria among the proper parameters for the distribution of ICMS resources. According to Loureiro (2002), this proposal emerged from a movement of municipalities in Paraná that sought financial compensation for having a large part of their territory characterized as areas of environmental protection, reducing the potential of other economic activities that generate dividends. Thus,





Paraná was a pioneer in establishing environmental criteria as a measure for the distribution of ICMS among its municipalities. The State Complementary Law N °. 59/1991 defined that the relevant environmental criteria for the state would be the existence in the municipality of supply springs and Conservation Units, and Portaria N °. 263/1998 of the Environmental Institute of Paraná (IAP-PR) added criteria such as land registry, size, quality of the protected area and category of management as relevant for the transfer calculations.

After the creation of ICMS-E in Paraná, another 16 states drafted and passed laws with these same proposals. Paraíba, although already having legislation of ICMS-E (Law No. 9,600 / 2011), until January 2018, did not implement it due to legal questions about its constitutionality (Castro et al., 2018).

It is believed that the ICMS-E can be understood as a mechanism of federative coordination as it adjusts the actions of the municipalities to the interests of the states. This mechanism, depending on the characteristics of its legislation, uses positive competition among municipalities for more state funds, based on the criteria stipulated by the state.

The states defined quite different environmental criteria for the distribution of the ICMS share. Among these criteria it is possible to mention the existence of Conservation Units, sources of water supply, waste collection and recycling systems; characteristics and quality of environmental management, focusing on the creation of Municipal Councils and Funds for the Environment; as well as the existence of environmental policies for reforestation, fire-fighting, and others.

The percentage of the distributed ICMS-E quota, as well as the calculation of the distribution of state resources, is very diverse, with proposals to create performance rankings, accounting for quality criteria or importance of the areas to be preserved. In some cases, these calculations are difficult to understand, and the lack of transparency in the disclosure of accounting and the selected criteria for estimating the ICMS-E does not favor the involvement of municipalities in this policy (Castro et al., 2018).

The lack of awareness of the ICMS-E by the municipal managers was pointed out by different works (Ribeiro et al, 2013, Uhlmann, 2010 and Moreira, 2004) and has been faced by several



states that promote workshops and seminars to publicize politics (Rio de Janeiro , Mato Grosso, Goiás, among others). However, other states are still effective in this disclosure.

As a coordination mechanism, the ICMS-E needs to be publicized, since its knowledge guarantees municipal engagement. In other words, if states do not make extensive communication about ecological ICMS, their criteria, calculations and transfers, there will be less incentive for municipalities to meet the environmental criteria stipulated, making this proposal innocuous (Castro et al., 2018).

## Methodology

With the objective of analyzing the characteristics of the environmental criteria used by the states for the sharing of the ICMS-E, a research was done of the legislation of each state that implemented it until 2018 (which excludes Paraíba). The characteristics analyzed were:

- (i) Year of creation of the ICMS-E law;
- (ii) Percentage for ICMS-E;
- (iii) The degree of additionality (High, Medium, Low or Non-existent), understood as the existence of incentives to municipalities to increase their environmental management efforts, through quantitative or qualitative criteria, which induces a positive competition between them.

Legislation is classified as high additionality if it adopts criteria that reward municipalities where there is a better performance in environmental management. In contrast, in legislation with low additionality, the criteria adopted make little difference in municipal efforts to improve their environmental performance. Examples of non-additional criteria are those based on size of municipality and population, as they do not vary due to the improvement of environmental management (Table 1).



Table 1. Characteristics of the ICMS-E legislation in the states that implemented the policy until January 2018.

	<b>Initial year</b>	<b>% of ICMS-E</b>	<b>Additionality</b>	<b>Criteria that encourage municipal expenditure</b>
Acre	2004	5.00%	Low or inexistent	Although the calculation of the indexes considers the size of the Conservation Units, the correction factor according to area and population gives great importance to the size of the municipality and population.
Amapá	1996	1.40%	High	The pass-through criteria consider the size and quality of protected areas, and the improvement of performance in each criterion increases the municipality's score.
Ceará	2007	2.00%	Low or inexistent	Only state that does not have UC criteria. The calculation of the transfer is based on qualitative criteria of solid waste management, but without variation if there is performance improvement in relation to a criterion already met.
Goiás	2011/14	5.00%	Low or inexistent	Review based on the number of minimum criteria served by the municipality, but without variation if there is performance improvement in relation to a criterion already met.
Mato Grosso	2000	5.00%	Medium	The transfer is calculated by the size of the protected areas within the municipality.
Mato Grosso do Sul	1994	5.00%	High	Criteria consider the size and quality of protected areas, and the quality of solid waste treatment and selective collection.
Minas Gerais	1995	1.10%	High	The transfer is calculated by quantitative and qualitative criteria for Conservation Units, and qualitative criteria for the final treatment and disposal system for waste and sanitary sewage.
Pará	2012/14	8.00%	Medium	The criteria consider the size of conservation units.
Paraná	1991	5.00%	High	The index is calculated based on quantitative and qualitative criteria (better performance increases the score), besides

				giving greater importance to the municipal Conservation Units.
Pernambuco	2000	3.00%	Medium	The ICMS-E criteria consider the size and quality of Conservation Units, but do not consider the quality of treatment systems or final disposal of solid waste.
Piauí	2008/16	5.00%	Low or inexistent	Transfers based on the number of minimum criteria achieved by the municipality, but without variation if there is performance improvement in relation to a criterion already met.
Rio de Janeiro	2007	2.50%	High	The transfer is calculated based on quantitative and qualitative criteria (better performance increases the score), besides giving greater importance to the municipal Conservation Units.
Rio Grande do Sul	1997	0.18%	Low or inexistent	Although nominally the transfer described as ICMS-E is 7% of the total, the value effectively transferred to the municipalities by the existence of protected areas is only 0.18% (most of the transfer is a function of the total area of the municipality, independent use or environmental criteria).
Rondônia	1996	5.00%	Medium	The ICMS-E criteria consider only the areas of Conservation Units in the municipality in proportion to the areas of PAs in the state.
São Paulo	1993	0.50%	Low or inexistent	The ICMS-E transfer criteria consider only state protected areas and do not consider qualitative management criteria.
Tocantins	2002	13.00%	High	The ICMS-E index is based on several quantitative and qualitative criteria that vary according to the best performance of the municipality.

Source: Own elaboration

Table 1 shows that despite the increase in the number of states that have created ICMS-E legislation over time, there are still 10 Brazilian states where such initiative was not undertaken. It is also observed that the percentage of the ICMS quota distributed according to environmental



criteria varies between 0.18% (in Rio Grande do Sul) and 13% (in Tocantins), but the most used is 5%.

With the research carried out, it is possible to highlight the states of Amapá, Mato Grosso do Sul, Minas Gerais, Paraná, Rio de Janeiro and Tocantins, as those that have ICMS-E laws that stimulate positive competition among municipalities, those who incur greater environmental expenses. With emphasis on the states of Tocantins that has the highest ICMS-E index and for Rio de Janeiro and Paraná, which give greater importance to the Municipal Conservation Units.

An interesting aspect of the ICMS-E is that state legislations maintain their general principles, while having different characteristics and models. Thus, their study can identify cases that reach more promising results than others, improving the use of this tool by public management.

In this way, several authors sought to analyze the impacts of ICMS-E in different states. Some studies were related to the understanding of the impact of the ICMS-E on the creation of Conservation Units (Loureiro, 2002; Klein et al., 2009, Pinto et al., 2015, Fernandes et al., 2011, Oliveira and Murer, 2010, Silva Júnior et al., 2013, Matsubara, 2017, Castro et al. 2018). Other studies point to the impact on municipal management, with the creation of Municipal Environmental Councils and the encouragement of the improvement of environmental indicators (Moreira, 2004; Nogueira et al., 2013). Other studies discussed the calculation methodology of ICMS-E (Reis et al., 2016). However, few studies compare the ICMS-E in the different states in which it is implemented, and relate the incentive to municipal expenditures with the Environmental Management Function, which is the proposal of this study.

Descriptive statistics and regression analyzes were carried out by Ordinary Least Squares (OLS) with fixed effects in year and Federal Unit to verify how the adoption of sustainable practices by the municipalities, measured from the expenses with the Environmental Management Function, is influenced by the receipt of ICMS-E, by the number of inhabitants and HDI-M.



## Data collection

In order to carry out this study, the following data were collected from all Brazilian municipalities, from 2012 to 2016, in the Accounting and Fiscal Information System of the Brazilian Public Sector (Siconfi): municipal budget revenues, total ICMS share of municipalities by state, and expenses with the Environmental Management Function.

The data of Ecological ICMS (ICMS-E) were obtained from the State Secretariats of the Environment and Finance, in their electronic sites, as well as through telephone calls and electronic messages. It is important to emphasize that there was a certain difficulty in obtaining these data, and precisely its lack limited the study period. The mentioned data were obtained by municipality and later aggregated for the accomplishment of the analyzes by state. The population of the municipality was extracted from the IBGE and the HDI of the municipalities was taken from the Atlas of Human Development in Brazil (2013), prepared by UNDP.

Paraná, Pernambuco and Rio de Janeiro directly provided the nominal values of ICMS-E transferred to each of their municipalities. In the other states, the amounts were calculated through the ICMS-E indices provided by state legislation or by public managers. All values were inflated for the year 2016 based on the implicit GDP deflator (IBGE).

"Function" expenditures, according to the Technical Budget Manual (Brazil, 2017), are the highest level of aggregation of the various areas of activity of the public sector, and this classification is used by all federative entities. Expenditures for the "Environmental Management Function" include all programs and actions carried out for the area, from common to compulsory expenses, including salaries and social contributions of public servants, and include the following subfunctions: 541 - Preservation and Environmental Conservation; 542 - Environmental Control; 543 - Recovery of Degraded Areas; 544 - Water Resources; 545 - Meteorology (Ordinance No. 42/1999).

Total municipal tax revenue was adopted, not only the fiscal revenue, because most municipalities in Brazil have low collection capacity and depend heavily on federal and state transfers (GOMES & MAC DOWELL, 2000). According to FIRJAN (2017), 81.7% of

Brazilian cities were not able to generate 20% of their revenues in 2016. In addition, from the point of view of expenditure allocation, the most important element for environmental expenditure of the municipality is its ability to pay, regardless of whether resources come from own collection or transfers.

Finally, it should be pointed out that the states that do not have ICMS-E were also analyzed as a control group, in order to verify if the causalities presented in this study refer to the transfer of ICMS quota from criteria environmental trends or a general trend.

## Results

Table 2 shows the total amount of ICMS-E passed on from the states to the municipalities in the period 2012-2016. These values depend directly on the economic activity of each state, but also on the transfer coefficients that vary widely, as can be seen in Table 1. However, the total value of the transfer is significant, reaching R\$ 1.9 billion in 2016 .

Table 2. Value of ICMS-E transferred to municipalities, by State, 2012-2016 (R\$ Million 2016)

State	2012	2013	2014	2015	2016
Acre	7.7	10.1	12.2	13.1	12.3
Amapá	3.0	3.4	2.8	2.4	2.0
Pará	0	0	42.4	84.4	120.3
Rondônia	45.5	43.6	41.8	43.9	40.8
Tocantins	65.4	68.6	69.7	69.3	72.8
Ceará	48.5	52.2	52.9	50.2	48.2
Pernambuco	0	85.7	87.3	82.1	81.4
Piauí	0	0	0	0	42.0
Goiás	0	0	174.9	174.6	164.4
Mato Grosso	97.5	99.6	101.6	98.8	105.3
Mato Grosso do Sul	74.8	78.9	79.6	75.5	71.7

Minas Gerais	97.1	102.6	100.3	91.5	91.9
Rio de Janeiro	232.5	223.0	227.7	240.0	225.5
São Paulo	146.4	155.1	171.6	165.8	152.1
Paraná	300.6	324.9	321.8	344.0	323.7
Rio Grande do Sul	0	0	445.1	435.6	444.6
<b>TOTAL</b>	<b>1,119.0</b>	<b>1,247.6</b>	<b>1,931.5</b>	<b>1,971.4</b>	<b>1,999.0</b>

Source: Own elaboration

The first analysis was the comparison of the average percentage of participation of the expenses with the Environmental Management Function on the total expenses of the municipalities that receive and do not receive ICMS-E. The average of this percentage in municipalities located in states that have received ICMS-E for the longest time (Acre, Amapá, Ceará, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Rondônia, São Paulo and Tocantins) is 0.65%, well above the average of 0.28% of municipalities in states that do not have legislation on the subject. The municipalities of the states with recent legislation on the subject (Pará, Piauí and Goiás) are in an intermediate situation, with an average of 0.46% (Table 3).

Table 3. Municipal average of expenses with the Environmental Management Function/total expenses, ICMS-E/total revenue, HDI-M and population, by State, 2012/16

State	Environmental Expenditure / Total Expenditure (%)	ICMS-E/ Total Revenues (%)	Average IDH-M	Average Population
States without ICMS-E legislation				
Alagoas	0.18%	0.00%	0.566	34,663
Bahia	0.19%	0.00%	0.595	37,035
Sergipe	0.19%	0.00%	0.597	29,813
Maranhão	0.20%	0.00%	0.576	32,467



Paraíba	0.32%	0.00%	0.588	17,824
Santa Catarina	0.36%	0.00%	0.728	23,032
Rio Grande do Norte	0.37%	0.00%	0.612	21,265
Roraima	0.44%	0.00%	0.617	36,589
Amazonas	0.45%	0.00%	0.566	64,183
Espírito Santo	0.51%	0.00%	0.692	49,240
<b>States with old ICMS-E legislation</b>				
Pernambuco	0.44%	0.24%	0.596	50,722
São Paulo	0.54%	0.34%	0.740	68,262
Minas Gerais	0.46%	0.41%	0.668	24,647
Ceará	0.39%	0.52%	0.617	48,182
Amapá	1.48%	0.70%	0.645	52,896
Rondônia	0.21%	1.23%	0.644	31,155
Rio Grande do Sul	0.75%	1.25%	0.713	22,626
Acre	0.52%	1.39%	0.587	36,320
Rio de Janeiro	1.26%	1.54%	0.709	182,451
Paraná	0.87%	1.61%	0.702	27,788
Mato Grosso	0.27%	1.92%	0.685	23,476
Mato Grosso do Sul	0.65%	2.03%	0.672	33,966
Tocantins	2.03%	2.95%	0.640	10,656
<b>States with recent ICMS-E legislation</b>				
Piauí	0.43%	0.00%	0.572	14,754
Pará	0.52%	0.53%	0.585	64,552
Goiás	0.45%	1.22%	0.695	27,323

Source: Own elaboration

It is important to note that among the states with the highest proportion of municipal expenditures with the Environmental Management Function are those with ICMS-E legislation



with qualitative criteria, especially Tocantins, Amapá, Rio de Janeiro and Paraná. This result indicates that such legislation is more effective in encouraging municipalities to spend more on environmental management in order to improve their performance in the ranking of resource allocation, in the same line as argued by the literature (see Castro et al., 2018).

The municipal average of the relative participation of expenses with the Environmental Management Function was also compared within each state with older legislation of ICMS-E (edited until 2007). In all of these states, the average of environmental management expenditures in municipalities benefiting from ICMS-E (varying from 0.29% to 2.03%) is higher than that of municipalities in those same states that do not receive ICMS-E (ranging from 0.0% and 0.86%). This is another evidence that the amount of ICMS-E received by the municipality is correlated with spending on environmental management.

In addition to indicating that there is a correlation between the percentage of expenditure with the Environmental Management Function and the existence of ICMS-E legislation, the data in Table 3 suggest that expenditures on environmental management increase as the relative participation of ICMS-E increases in the total revenue of the municipality.

This trend is seen in Table 4, which distributes the municipalities, by decile, as a function of the relative participation of ICMS-E in its total revenue. This relationship is not linear, and the proportion of expenditures with the Environmental Management Function only becomes more significant when the participation of ICMS-E assumes a larger proportion over its total revenues. This means that municipalities that receive relatively little ICMS-E in relation to their total revenues have average environmental expenditures slightly higher than municipalities that do not receive ICMS-E, but this relationship is more evident in the higher deciles. It is also noted that the increase in expenses with the Environmental Management Function is small compared to the increase in the participation of ICMS-E in the total revenue.

Table 4. Municipal average of expenses with the Environmental Management function/total expenses, ICMS-E/total revenue, HDI-M and population, per decile of ICMS-E ratio/total revenue, 2012/16

	Environmental Expenditure /Total Expenditure	ICMS-E/Total Revenues	IDH-M	Population
<b>States without ICMS-E legislation</b>				
Average	0,28%	0,00%	0,620	30,819
<b>States with recent ICMS-E legislation</b>				
Average	0.46%	0.63%	0.627	29,856
<b>States with old ICMS-E legislation</b>				
Don't receive	0.45%	0.00%	0.697	21,463
Decile 1 (0-10%)	0.71%	0.02%	0.705	243,959
Decile 2 (10-20%)	0.84%	0.12%	0.701	85,028
Decile 3 (20-30%)	0.64%	0.25%	0.681	36,761
Decile 4 (30-40%)	0.64%	0.40%	0.671	35,101
Decile 5 (40-50%)	0.62%	0.58%	0.665	29,146
Decile 6 (50-60%)	0.68%	0.83%	0.666	24,906
Decile 7 (60-70%)	0.68%	1.18%	0.677	16,638
Decile 8 (70-80%)	0.78%	1.75%	0.676	14,404
Decile 9 (80-90%)	0.96%	2.79%	0.666	13,324
Decile 10 (90-100%)	1.31%	8.03%	0.668	12,189

Source: Own elaboration

It is interesting to note that population size is inversely related to the proportion of environmental management expenditures. Larger municipalities tend to have a lower ratio between ICMS-E and total revenue due to the diversification and scale of revenues received, including by own collection. This explains the inverse relationship between population size and the participation of ICMS-E in total revenue. On the other hand, by dealing with more complex environmental problems, due to the greater concentration and urban density, these municipalities tend to spend more on environmental management. Moreover, in a

heterogeneous country such as Brazil, the effects of human development differentials between municipalities should not be disregarded.

To better understand the correlation of environmental expenditures with the transfer of ICMS-E, a regression analysis was performed considering the dependent variable "Environmental Expenditure/Total Expenditure" (Regression 1), which is the proportion of municipal expenditures with the Environmental Management Function in relation to total expenditure of the municipality, and the dependent variable "Environmental Spending" (Regression 2), which is only the amount spent with the Environmental Management Function. The variables "ICMS-E /Total Revenue" (Regression 1), which is the participation of the state transfer of ICMS-E in the total revenues of the municipality, and the variable "ICMS-E" (Regression 2), were used as explanatory variables. which represents the total passed on to the municipality by the environmental criteria of the ICMS law. As control variables, the HDI-M and the population of the municipality were used, in addition to the controls of fixed effects of year and States. Table 5 shows the results of the regressions.

Table 5. Result of regression analysis

Independent Variables	Regression 1	Regression 2
	Environmental Expenditure/ Total Expenditure	Environmental Expenditure
ICMS E/Total Revenues	0.0640***	
ICMS E		0.157***
ln (IDH-M)	0.0113***	1.236e+06***
ln (Population)	0.00142***	541,451***
Total Revenues		0.00604***
Fixed Effect for Year	-0.000435**	-129,143*
Constant	-0.00375***	-4.377e+06***
Observations	26,390	26,390
R <sup>2</sup>	0.121	0.669
Robust standard errors: *** p<0.01, ** p<0.05, * p<0.1		

Source: Own elaboration

In "Regression 1" of Table 5, the proportion of expenditures with the Environmental Management Function is significantly correlated with the participation of the ICMS-E in the total revenues of the municipalities. The coefficient in the household of 6% indicates that, on average, for each percentage point of "ICMS-E / Total Revenues" passed on to the municipality, the expense in environmental management is 0.06% higher. "Regression 2" also presents a positive and significant result between the transfer of ICMS-E and the amount of environmental expenditure of the municipality. The coefficient of the variable "ICMS-E" indicates that, on average, for each real transferred by the ICMS-E legislation to the municipalities, the expense in environmental management is R \$ 0.16 higher. In both regressions, the higher the HDI-M and the population of the municipality, the greater the spending on environmental management.

Finally, in order to better understand how the municipalities of states that receive ICMS-E commit their spending on environmental management in contrast to the states without ICMS-E, "Regression 3" - presented in Table 6 was performed. The states that do not have ICMS-E legislation were omitted, so that the coefficients in "Regression 3" are values in reference to the average of all these states: for example, if the coefficient of a state is 0.01, the municipalities of that state have, in average, an expense of 0.01 percentage points higher than the average of the states without ICMS-E legislation.

Table 6. Results of Regression 3, including fixed State effects

Independent Variables	Regression 3
	Environmental Expenditure/ Total Expenditure
ln (IDH-M)	0.00696***
ln (Population)	0.000102
ln (Total Revenues)	0.00155***
Rondônia	-0.00133**
Acre	0.00269***
Pará	0.00152***
Amapá	0.01170***
Tocantins	0.01850***
Piauí	0.00317***
Ceará	0,00037
Pernambuco	0.00109***

Minas Gerais	0.00163***
Rio de Janeiro	0.00611***
São Paulo	0.000515*
Paraná	0.00496***
Rio Grande do Sul	0.00395***
Mato Grosso do Sul	0.00228***
Mato Grosso	-0.000884**
Goiás	0.00108***
Fixed Effect for Year	-0.000502**
Constant	-0.0218***
Observations	26,390
R <sup>2</sup>	0.112
Robust standard errors: *** p<0.01, ** p<0.05, * p<0.1	

Source: Own elaboration

Table 6 shows that the states with the highest significant fixed effects are the same ones with the highest average municipal expenditure with the Environmental Management Function: Tocantins, Amapá, Rio de Janeiro and Paraná (according to Table 3) . This result also corroborates the hypothesis that ICMS-E legislation induces municipal expenditures on environmental management, and that the manner in which the criteria for sharing are established may increase this induction: as previously stated, ICMS-E laws Tocantins, Rio de Janeiro, Amapá and Paraná are legislations with a high degree of additionality (Table 1). Although these coefficients of fixed effects of the states capture the influence of other omitted variables, there is a great correlation between the coefficients of the "Regression 3" state and the degree of additionality: while states with high additionality have the highest coefficients (Tocantins, Amapá, Rio of Paraná), states with low or nonexistent degree of additionality have much smaller coefficients (São Paulo, Ceará, Goiás).

## Final considerations

The objective of this work was to investigate if there is any influence of Ecological ICMS on the environmental expenditure of the municipality. Different statistical exercises were carried





out with the percentage of the expenditure with the Environmental Management Function of the municipalities on their total expenditure in relation to variables such as ICMS-E as a proportion of total municipal revenue, population and HDI-M.

The results of this work confirm that the establishment of a public policy of positive incentives - in this case, the transfer of ICMS-E - can be effective to stimulate the municipalities to increase the expenses with environmental management. There is statistical significance in the correlation between the proportion of municipal expenditure with the Environmental Management Function and the relation between ICMS-E and the total revenues of the municipality.

On the other hand, attention is drawn to the low sensitivity of expenditure growth with the Environmental Management Function as a proportion of the total expenditure in relation to the increase of the ICMS-E in the total revenue of the municipality. This indicates that the effectiveness of ICMS-E as an incentive for spending on environmental management is still small.

This influence of the ICMS-E on municipal environmental management actions can be increased if the state legislation design favors criteria that encourage municipalities to invest in improving their environmental management to obtain greater transfers, paying more to those who invest more. This is evidenced by the greater correlation between the proportion of expenditures with the Environmental Management Function on total municipal expenditures in states where high additionality was identified, fostering positive competition among municipalities. In the same way, it can be seen that in states where the improvement of environmental management brings little return to the city, in terms of increased receipt of ICMS-E, the relation with the proportion of environmental spending is lower.

The scale of the transfer of ICMS-E also matters: it was identified that the correlation between the proportion of expenses with the Environmental Management Function and the relative importance of the ICMS-E in the municipal revenue becomes much more evident when the value of the latter exceeds 1% . That is, the share of ICMS-E to be passed on to the municipality can not be too small, since this discourages the response by the local managers.



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Other factors also influence the decision of public expenditure on environmental management, such as the size of the population and its level of human development. A trend towards increased urbanization and the HDI-M may lead to an increase in the importance of environmental management policy. However, it is not possible to forget the importance of the expenditures with the Environmental Management Function in the smaller and / or less developed municipalities, but that receive higher transfers of ICMS-E in relation to their total revenues.

This paper has shown that ICMS-E is an important instrument of coordination between state intentions and municipal actions. However, the main difficulties for this policy to be successful in increasing municipal expenditures on environmental management are: the elaboration of legislation that encourages the expansion of municipal environmental spending and the widespread dissemination of this policy.

The first challenge must be faced in state assemblies that should privilege positive competition among municipalities, so that they receive more resources if they invest more in environmental management, taking into account quantitative and qualitative criteria. The second challenge can be seen in the scope of state management, increasing the communication to the municipalities about the objectives of the policy, its criteria and calculations. This is because, the lack of transparency and lack of communication does not favor coordination.

In any case, the ICMS-E proved to be an effective mechanism in stimulating the increase of environmental expenditures, although with low elasticity, positively influencing the decision-making of public agents. This type of construction can be extended to other development problems and administrative spheres: creating positive incentive systems, such as budgetary participation, access to public funds or other forms of economic incentive, can induce a change in the behavior of public and private agents, and the quality of life of the population.



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