

The Effects of Grants and the Marginal Cost of Public Funds: Evidence from Brazilian States

Lucas Oliveira Gomes Ferreira^{a*}, André Luiz Marques Serrano^b, Federico Revelli^c

^{a,b}*University of Brasília, Campus Darcy Ribeiro - FACE Room AT4/5, Brasília - 70910-900, Brazil*

^c*University of Torino, Campus Luigi Einaudi - Lungo Dora Siena 100A, Torino - 10153, Italy*

^a*Email: lucasoliveira@unb.br*

^b*Email: andreims@unb.br*

^c*Email: federico.revelli@unito.it*

Abstract

The flypaper effect is the empirical anomaly by which intergovernmental grants tend to be transformed by recipient authorities into public expenditures at a considerably higher rate than local private resources. The objective of this research is to detect the existence and investigate the causes of the flypaper effect in the Brazilian states. Panel data evidence from 27 Brazilian states from 1985 to 2010 indicates the existence of a large flypaper effect, with an estimated impact of grants on public expenditures. Considering there are some ways to calculate MCF proxies, first, an autonomous index was used as a proxy of the marginal cost of public funds (MCF), because it represents how much the municipality can survive by itself, representing the municipalities' independency to federal grants. Second, the MCF was calculated by the derivation of Proper Tax Revenue to the Total Revenues. The results show that the stimulative effect of grants on public spending increases with the MCF in both proxies, but it was stronger in the autonomous index proxy, in convergence to results of [5] to Canadian provincial data.

Keywords: Brazilian states; marginal cost of fund; grants; flypaper effect.

* Corresponding author.

1. Introduction

The present study aims to analyze the Brazilian states and to test the hypothesis that the stimulative effects of intergovernmental grants increase with the marginal cost of public funds (MCF) of the recipient government, based on the research of [5] using Canadian provincial data. Tax autonomous was used as a proxy of the MCF, considering the rate of proper taxes in relation to the total revenues of the state [5] found stimulative effects of lump-sum grants on spending increase with the provincial government's MCF. There are many unconditional and nonmatching grants in Brazil: the State Participation Fund (FPE), the Municipal Participation Fund (FPM) and percentages of the Rural Property Tax (ITR), the Financial Transactions Tax (IOF), the Tax on Circulation of Goods and Services (ICMS), the Motor Vehicle Tax (IPVA) and the Federal Value-Added Tax or Excise Tax on Manufactured Goods (IPI). However, the present study uses only the FPE as a proxy to unconditional and nonmatching grants (lump sum). Even though the large literature about flypaper effect in Brazil ([23], [31], [24]), there is still no conclusive evidence on the size of the flypaper effect in this country, neither a study considering the MCF. There is an association of distortionary taxes with the flypaper effect, considering transfers has a "price effect", as well as an "income effect", allowing the recipient government to reduce the tax rate and, consequently, lowering its marginal cost of public funds, maintaining the public service level [6]. Hence, the reduction of the effective price is the cause of boosting spending. By this way, receiving grants causes much larger effect on spending than an increase in personal income [5]. Therefore, the objective of the present paper is to analyse the existence of flypaper effect on the 27 Brazilian states by panel data from 1985 to 2010. Further, two ways to deal with Marginal Cost of Funds were developed to address the importance of it in the transfers within Brazil federalism. The first one was based on an autonomous index, which is how much autonomous with proper taxes are the states faced to all the taxes and grants they receive from the federal level. The second one is based on the residuals of proper revenues and total revenues as an equation. About this last one [5] did a similar analysis of the Canadian. Moreover, other ways were done in the same topic [22] employed an empirical methodology that is very similar to [5] and identified that block grants have stimulative effects on provincial education expenditure. This work is structured as follows. Section 2 discusses the state of the art of the evidence on the flypaper effect at the international and national level and presents Brazil's institutional and fiscal structure details. Section 3 describes the methodology, while Section 4 reports and discusses the estimation results, and Section 5 concludes.

2. Theoretical Reference

Reference [10] did an extent analysis of the empirical fiscal illusion studies and one of the forms is called flypaper effect. The flypaper effect has been largely studied ([39], [58]) and is treated as an anomaly because it is inconsistent with the "equivalence theorem" [19]. The "flypaper effect" happens when an unconditional lump-sum grant to a local government increases spending in a greater proportion than an equivalent raise in local income ([39], [52]). The phenomenon was first named by Arthur Okun, because the money the government sends out "sticks where it hits" [22], for example, investigated the effects of block grants on education expenditures using panel data from Canadian provinces over the period 1982 to 2008 and found out that block grants have stimulative effects on provincial education expenditure. A one dollar increase in per capita federal grants was associated with an increase in per capita education expenditure of about Can\$0.21, disclosing the

flypaper effect in Canada. There are evidence of flypaper effect all over the world: Reference [66] – Turkey, Reference [33] – South Africa, Reference [46] – Denmark, Reference [63] – German, Reference [29] – Spain, Reference [17] – Spain, Reference [61] – Kenya, Reference [51] – Mexico, Reference [12] – US, Reference [42] – US, Reference [15] – US, Reference [57] – US, Reference [56] – US, Reference [62] – US, Reference [34] – Indonesia, Reference [18] – England and Germany, Reference [2] – US, Reference [64] – Canada, Reference [44] – Brazil, Reference [8], [9] – Australia). Also in private sector firms: Reference [40] – US firms, Reference [32] – Peru and [43] – Spain. In the South America, Reference [52] shows new estimates in the presence of spatial dependence, when local spending is not independent from its neighbor jurisdictions' behavior. By Argentinean county-level data (Buenos Aires), the study showed that while the “flypaper effect still holds true in the presence of spillover effects or mimic behavior across jurisdictions, it could be overestimated in the presence of spatial interdependence. In Brazil, there are also many studies about flypaper [28] identified stronger flypaper effect in municipalities with larger geographic areas. It is consistent with a budget-maximizing bureaucracy explanation of the flypaper effect, considering larger municipalities' residents wouldn't easily move to municipalities that might spend less on public services and offer lower taxes [60] searched a panel of Brazilian municipalities from 1989 and 2005 and found out that grants have an asymmetric impact on public expenditure and this effect generates a recomposition between current expenses and investments. Moreover, the results indicate that municipal public spending is more sensitive to increases in government transfers than increases in local income, which means flypaper effect [13] searched Argentinean provinces and Brazilian states and identified the presence of flypaper effect [45] searched 476 Brazilian municipalities from 2005 to 2012 and concluded that the flypaper effect exists in Brazilian municipalities and is intensified by the alignment of the representatives. Additionally, evidences of higher flypaper effect were found in municipalities with low tax autonomy [16] provides an explanation for the flypaper effect which is simply because public expenditures are cheaper when financed with intergovernmental transfers. A lump-sum increase in income can lead to three effects on optimal government decisions. The first one is the net substitution effect, which represents a change in public expenditures due to the induced change in the tax base and the MCF. The second is the private-income affect, a change in public expenditures due to greater taxpayers' income. The last is the public-income effect, a change in public expenditures due to additional public funds available to purchase public goods. Considering intergovernmental transfers do not directly alter taxpayer's decisions about the tax base, they lead only to a public-income effect. Brazil is a continental country, composed by the Union, 26 states, the Federal District and 5570 municipalities. Regarding to transfers, the Federal Government distributes resources to the states and the municipalities, while the states also distribute resources to the municipalities, with an active competence to collect certain taxes. It is a simple system [53], although the outcomes are complex to analyze effectiveness, as well as to verify the existence and respective reasons of occurrence of the flypaper effect. There are several types of transfers in Brazil, matching and non-matching. The flypaper is verified only when it results from non-matching grants, for instance the Municipal Participation Fund [25]. Non-matching grants could be susceptible to resource allocation maneuvers, mainly due to electoral alignment ([3], [47], [54]), but as the formula is fixed, based on population and per capita income, this weakness should be minimized.

2.1. MCF

It is important to analyze the MCF in the context of the flypaper because its isolated study can lead to erroneous

conclusions. Several authors did this analysis by robust studies ([49], [50],[41],[65],[5]). Some author’s explanations of the flypaper effect are directly or indirectly based on the MCF ([38], [6],[32]).

Initially, the concept of marginal cost of fund (MCF) is broadly described by [7]. In summary, it measures the loss incurred by society in raising additional revenues to finance government spending. The flypaper effect can be obtained when the MCF is greater than one and non-decreasing in the tax rate [16]. There are many ways to calculate MCF [7]. However, many estimates are not comparable, because there are many definitions of the same concept [21] and those who review theoretically the works show the diversity of estimates ([14], [7]). Some MCF’s works are shown below:

Table 1: Previous Studies

Author	MCF Proxy
Reference[38]	Intergovernmental transfers can stimulate public expenditures more than income increases because they normally lead to a greater reduction in the marginal cost of public funds (MCF).
Reference [6]	Grants can reduce the cost of taxation for local governments through a change in the MCF. Lump-sum grants allow the recipient government to reduce its tax rate, which in turn, decreases the MCF in order to keep the same level of public service.
Reference[21]	$MCF = -\Delta W / \Delta R$, where ΔW is a monetary measure of the change in social welfare and ΔR is the change in tax revenue arising from a marginal change in a tax instrument. The estimated MCF in Africa is 1.21.
Reference[32]	The flypaper effect is obtained when the marginal (administrative) cost of tax collections increases with the tax rate.
Reference[13]	For Argentinean provinces and Brazilian states, there is a positive association between the size of the flypaper effect and the level of the tax rate. Moreover, the flypaper effect should be larger the lower the elasticity of substitution between private and public spending and, in fact, should vanish for very high degrees of substitution.
Reference [5]	$MCF_{it} = S_{it} / (S_{it} + \tau_{it} \cdot \eta)$, where S_{it} is the share of total tax revenue from personal income tax base for province i in year t , τ_{it} is the personal income tax rate for province i in year t and η is the uniquely estimated semi-elasticity of the personal income tax base with respect to personal income tax rate.
Reference[16]	Fypaper effect can be explained as an optimal decision of a benevolent and efficient government constrained by taxpayers’ responses to taxation. The MCF does not need to change with transfers to produce the flypaper effect. It can be constant but needs to be greater than one. The simple underlying explanation for the flypaper effect is that public expenditures are cheaper when financed with transfers than when finance with income.
Reference[24]	For Local Governments in Brazil, an increase in R\$ 1.00 in per capita unconditional transfers reduces the local price effect (MCF) around 0.07%.

According to [6], benevolent local governments financing its expenditures with a distortionary tax predict flypaper effects, because lump-sum intergovernmental transfer has a “price effect” and an “income effect”.

Thus, these grants allow recipient governments to reduce its tax rate, which lowers its marginal cost of public funds, while can provide the same level of public service. “The reduction in the effective price of providing the public service helps to explain the flypaper effect” [6],[16] supports the flypaper effect can be obtained when the MCF is greater than one and non-decreasing in the tax rate. The reason is because an amount of income is lost before being made available to the government, while the same amount of transfers is readily available without costs. Hence, the flypaper effect does not require the MCF to be increasing in the tax rate ([38], [6], [5]). Besides, the flypaper effect can be obtained with a constant greater than one MCF [5] tested the hypothesis that the stimulative effects of intergovernmental grants increase with the marginal cost of public funds of the recipient government in Canadian provinces. The results indicate that the stimulative effects of lump-sum grants on spending increase with the provincial government’s marginal cost of public funds (MCF). Reference [24] document empirical evidence on price-effect caused by lump sum grants for Brazilian municipalities from 2006 to 2010 and found out that an increase in R\$ 1.00 in per capita unconditional transfers reduces the local price effect (MCF) around 0.07%. Considering the MCF is often calculated by the tax rate, in Brazil is very difficult to take a single tax rate or the median of them, because there are many types of taxes and many tax rates. To exemplify, [45] show the States Participation Fund (FPE), which is a percentage of 48% of the total of two Federal taxes: Income tax (IR) and Federal value added tax or excise tax on manufactured goods (IPI). Moreover, the states receive four more grants from Federal level (Residual taxes, Financial transactions tax (IOF), Contribution of Intervention in the Economic Domain on fuels (CIDE) and Federal value-added tax or excise tax on manufactured goods on exportation (IPI-Exp)). Each of these taxes has different tax rates, considering the particular situations, the taxpayer conditions and particular exceptions [11]. For example, companies can pay 15% or 25% of Income tax (IR), depending on how much is the year earnings. The employees can pay four tax rates (7,5%, 15%, 22,5% and 27,5%), depending on the tax base of each employee. Thereupon, it’s hard to stablish a tax rate to a Brazilian state, for example. Furthermore, the percentages of FPE the states receive are defined every year by the Federal Court of Accounts (TCU), based on Population size and Gross Domestic Product (GDP):

Table 2: FPE Percentages

n	State	FPE Coefficient (%)	n	State	FPE Coefficient (%)
1	Acre	3.4210	15	Paraíba	4.7889
2	Alagoas	4.1601	16	Paraná	2.8832
3	Amapá	3.4120	17	Pernambuco	6.9002
4	Amazonas	2.7904	18	Piauí	4.3214
5	Bahia	9.3962	19	Rio de Janeiro	1.5277
6	Ceará	7.3369	20	Rio Grande do Norte	4.1779
7	Distrito Federal	0.6902	21	Rio Grande do Sul	2.3548
8	Espírito Santo	1.5000	22	Rondônia	2.8156
9	Goiás	2.8431	23	Roraima	2.4807
10	Maranhão	7.2182	24	Santa Catarina	1.2798
11	Mato Grosso	2.3079	25	São Paulo	1.0000
12	Mato Grosso do Sul	1.3320	26	Sergipe	4.1553
13	Minas Gerais	4.4545	27	Tocantins	4.3400
14	Pará	6.1120	Total		100

Considering this situation and the difficulty of building a MCF proxy, it’s possible to calculate the amount each state receive from grants and how much do they earn by local taxes. The result (called by us as Autonomous

Index) fits as a MCF proxy, because it represents exactly how much autonomous is the state in relation to the Federal level. It shows how much the municipality can survive only by itself, taxing and earning funds by its own. Thus, it's one of the ways to know the municipality's independency.

3. Methodology

3.1. Data

The sample consists of a panel of 27 states from 1985 to 2010. An additional analysis was done excluding the Federal District, because it represents a hybrid entity accumulating state and municipality functions. Current expenditure and grants data were obtained from Finbra's Finance System, while GDP and population data were obtained from the IBGE database. The monetary variables were deflated. The period from 1985 to 2010 was tested because all the variables were available, including the controls variables. However there are some available data until 2016, it was preferable to use the data from 1985 to 2010 because all the controls were available, which is more reliable and stable considering the deflated applied to the data. There are some similarities between Argentina and Brazil, because while Argentina is divided into 23 states or provinces and a Federal District (Buenos Aires City) and the province of Buenos Aires accounts for one third of total population and half of the GDP of the country [52]. While Brazil has 26 states and a Federal District and it accounts for 1.43% of total population [35] and 3.8% of the GDP of the country [36].

3.2. Variables

Several previous works have studied the determinants of local public expenditures [5]. We use here current expenditure as the dependent variable, and state GDP as a proxy for the private income variable. The nonmatching and unconditional (lump sum) grant that we use is the federal grants State Participation Fund (FPE). Therefore, some authors have used grant proxies with more components as [27], [48] and in general other studies consider FPM, IOF, ICMS and IPVA [27]. The grants FPE is unconditional and nonmatching (lump sum) grant.

3.3. Controls

The following variables were used as controls in the expenditure determination equation: Gini index, Theil index, citizen's income, water bodies and illiteracy rate. Initially, we performed a detailed analysis of the classification of nonmatching unconditional (lump sum) grants in Brazil and considered only grants in congruence to the theory of flypaper effect, with is the FPE. There are evidences that states with political alignment receive more grants and have greater effect flypaper [59], however, it was not done in the state level. The database is from 1985 to 2010 because the control variables are available only until 2010 (gender, youth, elderly), since they are frequently discontinued in Brazil and this was the longest observable time series of these variables. The data availability of these control variables was questioned in the Federal Government Transparency Portal, but it was informed the data and research were actually discontinued and there is no prospect of further updates. Another limitation refers to state GDP data, which are available only two years after the end of the year it refers to [35].

3.4. Econometric Model

An index of tax autonomy was used to test if financial constraints can be responsible for the flypaper effect. This index represents how much autonomous the states are in collecting their own taxes ([37], [49], [50], [41], [67], [5]). This index is represented bellow:

$$MCF_{it} = \text{Proper Tax Revenue}_{it} / \text{Total Revenue}_{it} \quad (1)$$

where *Proper Tax Revenue_{it}* represents the sum of the Current Tax Revenues and Contributions Revenues items, which includes all the five taxes that the STF stated, which are: taxes, fees, improvement contribution, compulsory loan and contributions in general. Total *Revenue_{it}* is the sum of Current Revenues and Investment Revenues.

After calculating the index, equation (2) was estimated including an interaction between MCF and Grants:

$$Exp_{it} = \beta_0 + \beta_1 Grant_{it} + \beta_2 MCF_{it} + \beta_3 MCF_{it} * Grant_{it} + \beta_4 GDP_{it} + \beta_5 Controls_{it} + \epsilon_{it} \quad (2)$$

where *Exp_{it}* is the current expenditure of the state *i* in the year *t*, *Grant_{it}* is the nonmatching and unconditional (*lump sum*) transfers of the state *i* in the year *t*. In the present study, *Grant_{it}* is the federal transfer to the states called FPE, considering it is constitutional and clearly exogenous as the federal transfer to the states, according to [27]; *GDP_{it}* is the Gross Domestic Product of the state *i* in the year *t*, and *Controls_{it}* are Gini index, Theil index, citizen's income, water bodies and illiteracy rate; and ϵ_{it} is the residuals ($i = 27$ states and $t = 1985$ to 2010). The model allows the stimulative effects of grants on government spending to depend on the *MCF_{it}*. The most important coefficient is β_3 , because it represents if the stimulative effect of grants on public spending increases with the MCF as predicted by [5], we expect $\beta_3 > 0$. The expected result is a positive and significant coefficient of the interaction variable between MCF and Grant (β_3) [5]. Also the monetary variables (*Exp_{it}*, *GDP_{it}* and *Grant_{it}*) were considered as per capita, deflated by the General Market Price Index – Internal Availability (IGP-DI), as with the previous analysis ([27], [48], [45], [24]). The data have a small cross-section (27 states), but a large time series of 26 years. Some tests do not make sense in short panels ([20], [30]) as cointegration, normality ([55]), serial correlation [1] and multicollinearity [4]. In consequence, they were not done in the present study. Regarding to collinearity, Reference [26] warned that ICMS state grant in their model may have generated collinearity, since its collection is determined by the state GDP. However, they argued that the importance of this type of transference is low in relation to the total grants. Another problem can be the high correlation between expenditure, GDP and grant variables. Future studies can deepen the theme and verify the interrelationship between these variables. Finally, with regard to heteroskedasticity, it was not even possible to calculate according to the extent of the panel. Therefore, the econometric assumptions were followed and adopted based on the previous literature and according to the panel length. According to [24], there is another way to calculate the MCF, which is presented in the following model:

$$MCF_d_{it} = \partial(\text{Proper Tax Revenue}_{it}) / \partial(\text{Total Revenue}_{it}) \quad (3)$$

which is similar to the eq. 1, but the new *MCF_d_{it}* is calculated by the derivation of *Proper Tax Revenue_{it}* to the

Total Revenue_{it}. Thus, the residuals ϵ_{it} of the equation below are considered the new MCF_d_{it} :

$$Proper\ Tax\ Revenue_{it} = \beta_1 + \beta_2 Total\ Revenue_d_{it} + \epsilon_{it} \quad (4)$$

after calculating the MCF_d_{it} , equation (5) was estimated, which includes interactions of MCF_d_{it} and $Grant_{it}$, similar to equation (2):

$$Exp_{it} = \beta_0 + \beta_1 Grant_{it} + \beta_2 MCF_{it} + \beta_3 MCF_d * Grant_{it} + \beta_4 GDP_{it} + \beta_5 Controls_{it} + \epsilon_{it} \quad (5)$$

considering the different forms to calculate the MCF [7], this procedure helps to guarantee the robustness of the study.

4. Empirical Results

Descriptive statistics of the variables used in the model, with tests of difference between means of the state aligned and unaligned by coalition or party, are shown in table 3:

Table 3: Descriptive Statistics – Aligned versus Unaligned States

Variables	Without Federal District						With Federal District					
	Mean	Avg	Std.Dv	Smalle st	Larges t	O bs	Mean	Avg	Std.Dv	Smalle st	Larges t	O bs
Exp	1.491	1.593	.802	0	5.828	69	1.536	1.752	1.213	0	11.740	67
GDP	9.855	11.560	5.490	3.788	30.243	70	10.150	12.939	8.869	3.788	58.489	67
Grant	.269	.496	.651	0	4.781	69	.260	.483	.643	0	4.781	67
MCF	.461	.447	.209	0	.907	69	.458	.445	.210	0	.907	67
MCF*Grant	.117	.144	.126	0	.679	69	.108	.141	.125	0	.679	67
MCF_d	-	-	9.25e+09	-	9.98e+10	69	22.864	-	9.09e+09	-	9.98e+10	67
MCF_d*Grant	25.640	2.86e+09	3.66e+09	3.66e+09	10	9	-	2.81e+09	9.09e+09	3.95e+09	10	3
Controls	-	-	2.27e+09	-	9.85e+09	69	-	-	2.22e+09	-	9.85e+09	67
Gini	1.11e+09	4.90e+08	1.59e+10	1.59e+10	09	6	1.06e+09	4.58e+08	1.58e+10	1.58e+10	09	0
Theil	.556	.552	.065	0	.666	70	.559	.554	.065	0	.666	67
Citizen's income	.636	.647	.150	0	1.313	70	.643	.649	.148	0	1.313	67
Water	618.40	648.64	260.94	0	1503.3	70	630.45	679.16	306.20	0	2279.6	67
Illiteracy	.802	.753	.204	0	.997	70	.815	.761	.204	0	.997	67
	.133	.165	.104	0	.505	70	.130	.161	.104	0	.505	67
						2						6

Source: authors. All monetary variables are per capita and deflated to 2010 by the General Market Price Index – Internal Availability (IGP-DI). The results show the Federal District contributes to higher the mean and average

of the monetary variables, mainly because it accumulates state and municipality functions. It's also possible to observe that the Gini index increases when the Federal District is added to the sample, indicating the inequality increasing, which is true, because the Federal District has higher Gini index. The results of eq. 2 are presented by the table below:

Table 4: Identified flypaper effect constitutional grants (robust) with MCF

Variables/Models	Without Federal District			With Federal District		
	(1)	(2)	(3)	(4)	(5)	(6)
Grant	0.447 (.038)***	.126 (.071)*	.153 (.066)	.552 (.059)***	.176 (.103)*	.153 (.104)
MCF		-.731 (.128)***	-.736 (.120)***		-1.521 (.188)***	-1.582 (.185)***
MCF*Grant		1.096 (.275)***	1.159 (.274)***		1.485 (.413)***	1.354 (.439)***
GDP	0.045 (.008)***	.125 (.006)***	.060 (.008)***	.092 (.007)***	.111 (.005)***	
Gini	2.306 (.696)***		1.746 (.766)**	2.834 (1.152)**		.969 (1.254)
Theil	-.922 (.272)***		-.726 (.277)***	-1.346 (.459)***		-.779 (.463)*
Citizen's Income	.001 (.000)***		.000 (.000)***	.000 (.000)		.000 (.000)
Water bodies	-.263 (.180)		-.510 (.195)***	-.296 (.281)		-.287 (.301)
Illiteracy	-1.663 (.432)***		-2.012 (.443)***	-1.361 (.683)**		-1.651 (.680)**
Dummy Years	No	No	No	No	No	No
States fixed effect	No	No	No	No	No	No
Year fixed effect	No	No	No	No	No	No
Obs	672	672	672	698	698	698
States	26	26	26	27	27	27
R ²	0.748	0.551	0.751	0.886	0.926	0.930
Wald chi2(7)	785.28***			503.08***		
Wald chi2(4)		561.64***			516.45***	
Wald chi2(9)			817.66***			611.56***

Source: authors. Robust standard errors are in parentheses. N = from 1985 to 2010. ***p< .01; **p< .05; *p< .1.

In the same way of [5], the results show the stimulative effect of grants on public spending increases with the MCF and $\beta_3 > 0$ is positive and significant in all the models the MCF variables are included (2, 3, 5, 6), as expected initially. Hence, it can be concluded that the stimulative effect of grants on public spending increases with the MCF. The above results of $\beta_1 > 0$ do not indicate the effects of grants on government expenditures due to the presence of the interaction term. Related to eq. 5, to verify another way of estimating the MCF, the results are presented below:

Table 5: Identified flypaper effect constitutional grants (robust) with *MCF_d*

Variables/Models	Without Federal District		With Federal District	
	(7)	(8)	(9)	(10)
Grant	.816 (.079)***	.726 (.087)***	.831 (.121)***	.845 (.147)***
MCF _d	.000 (.000)	.000 (.000)	-0.000 (.000)	-0,000 (.000)
MCF _d *Grant	.000 (.000)***	.000 (.000)***	0.000 (.000)**	0.000 (.000)*
GDP	.093 (.007)***	.046 (.008)***	.099 (.005)***	.096 (.007)***
Gini		2.803 (.708)***		3.307 (1.195)***
Theil		-.937 (.269)***		-1.366 (.463)***
Citizen's Income		.000 (.000)***		-.000 (.000)
Water bodies		-.434 (.196)**		-.308 (.301)
Illiteracy		-1.876 (.442)***		-1.463 (.693)**
Dummy Years	No	No	No	No
States fixed effect	No	No	No	No
Year fixed effect	No	No	No	No
Obs	670	670	696	696
States	26	26	27	27
R ²	0.506	0.738	0.895	0.901

Source: authors. Robust standard errors are in parentheses. N = from 1985 to 2010. ***p < .01; **p < .05; *p < .1. The results are aligned to [5], considering the results show $\beta_3 > 0$ and significant in models 7 and 8, while they are not strongly significant in models 9 (at 5%) and 10 (at 10%). Any of the coefficients were less than 0, which support the results are aligned to the expectations. However, considering they were not so higher than zero, the results show the many ways to calculate and estimate MCF ([7], [21]) can lead to different results. The MCF proxy as index of tax autonomy (eq. 1) shows results totally aligned to the results of [5]. Although, the MCF proxy as the derivation of Proper Tax Revenue to the Total Revenues (eq. 3) disclosures results aligned to [5], but not so strong, because the coefficient are closer to zero, and not higher than zero. Finally, it can be concluded that the stimulative effect of grants on public spending increases with the MCF.

5. Conclusions

The research about flypaper effect highlights the empirical anomaly that intergovernmental grants tend to be transformed by recipient authorities into public expenditures at a considerably higher rate than local private resources. The marginal cost of public funds (MCF) is one of the reasons flypaper effect exists, as many authors found relation between them [5], for instance, show that the stimulative effect of grants on public spending increases with the MCF. The objective of this research is to detect the existence and investigate the causes of the flypaper effect in the Brazilian states, by two proxies of MCF. The first is an autonomous index used as a proxy of the marginal cost of public funds (MCF), because it represents how much the municipality can survive by itself, representing the municipalities' independency to federal grants. Second, the MCF was calculated by

the derivation of Proper Tax Revenue to the Total Revenues. Panel data evidence from 27 Brazilian states between 1985 and 2010 indicates the existence of a large flypaper effect, with an estimated impact of grants on public expenditures. The results evidence that the stimulative effect of grants on public spending increases with the MCF in both proxies, but it was stronger in the autonomous index proxy, in convergence to results of [5] to Canadian provincial data. Future studies can test other proxies of MCF or other relations related to the flypaper effect and fiscal illusion. There are many ways to estimate the MCF, which highlight the need of studying the actual meaning and faithful of them. As there are many ways and also many models to consider MCF as a reason to the flypaper effect, other variables need to be considered, as population, social-economic characteristics, geographical considerations, as functions of the local governments to the community and to the whole country. Political aspects can also be considered, especially in Brazil, where the number of politicians is high and the electoral system is complex, because the way to calculate the votes is based not only on the number of votes the candidate owns, but also the votes its party win. Moreover, the grants from the federal level to state level is complex because it considers many kinds of taxes, as explained by [45]. Finally, the future researchers can deeper this analysis in the context of the flypaper effect.

Acknowledgements

This work was conducted during a scholarship supported by the International Cooperation Program CAPES at the University of Torino - Italy. Financed by CAPES – Brazilian Federal Agency for Support and Evaluation of Graduate Education within the Ministry of Education of Brazil.

References

- [1]. A. Bhargava, L. Franzini and W. Narendranathan. "Serial Correlation and the Fixed Effects Model." *Review of Economic Studies*, vol. 49(4), p. 533-549, 1982.
- [2]. A. Denzau and K. Grier. "Determinants of local school spending: some consistent estimates." *Public Choice*, vol. 44(2), p. 375-383, 1984.
- [3]. A. Rodríguez-Pose and N. Gill. "Reassessing Relations between the Centre and the States: The Challenge for the Brazilian Administration." *Regional Studies*, vol. 38(7), p. 833-844, 2004.
- [4]. A. S. Goldberger. "Multicollinearity. A Course in Econometrics." Cambridge: Harvard University Press. p. 245-53, 1991.
- [5]. B. Dahlby and E. Ferede. "The stimulative effects of intergovernmental grants and the marginal cost of public funds." *International Tax Public Finance*. vol. 23, p. 114-139, 2016.
- [6]. B. Dahlby. "The marginal cost of public funds and the flypaper effect." *International Tax and Public Finance*, vol. 18, p. 304–321, 2011.
- [7]. B. Dahlby. "The marginal cost of public funds: Theory and applications." Cambridge, MA: MIT Press, 2008.
- [8]. B. E. Dollery and A. Worthington. "Federal expenditure and fiscal illusion: a test of the flypaper hypothesis in Australia." *Publius*, vol. 25(1), p. 23-34, 1995a.
- [9]. B. E. Dollery and A. Worthington. "State expenditure and fiscal illusion in australia: a test of the revenue complexity, revenue elasticity and flypaper hypotheses." *Economic Analysis and Policy*, vol.

- 25(2), p. 125-140, 1995b.
- [10]. B. E. Dollery and A. Worthington. "The Empirical Analysis of Fiscal Illusion." *Journal of Economic Surveys*, vol. 10(3), p. 261-97, 1996.
- [11]. B. N. Lanzer. "Ensaio sobre o Custo Marginal do Financiamento Público no Brasil." Doctoral dissertation, UFRGS, Porto Alegre, 2011.
- [12]. B. Y. Clark and A. B. Whitford. "Does more federal environmental funding increase or decrease states' efforts?" *Journal of Policy Analysis and Management*, vol. 30(1), p. 136-152, 2011.
- [13]. C. A. Végh and G. Vuletin. "Unsticking the flypaper effect using distortionary taxation." *Económica*. Departamento de Economía, Facultad de Ciencias Económicas, Universidad Nacional de La Plata 62, p. 185-237, Jan.-D, 2016.
- [14]. C. L. Ballard and D. Fullerton. "Distortionary Taxes and the Provision of Public Goods." *Journal of Economic Perspectives*, vol. 6 (3), p. 117-131, 1992.
- [15]. C. B. Colburn. "The changing composition of income transfer programmes: a public choice analysis." *Applied Economics*, vol. 24(2), p. 161-168, 1992.
- [16]. C. F. Sepúlveda. "Taxpayers' Behavior and the Flypaper Effect." *Review of Public Economics*, vol. 222(3), p. 91-108, 2017.
- [17]. D. Cantarero and P. Perez. "Decentralization and regional government size in Spain." *Portuguese Economic Journal*, vol. 11(3), p. 211-237, 2012.
- [18]. D. De Widt. "Top-down and bottom-up: institutional effects on debt and grants at the English and German local level." *Public Administration*, vol. 94(3), p. 664-684, p. 2016.
- [19]. D. F. Bradford and W. E. Oates. "The Analysis of Revenue Sharing in a New Approach to Collective Fiscal Decisions." *The Quarterly Journal of Economics*, vol. 85(3), p. 416-439, 1971.
- [20]. D. N. Gujarati. "Basic Econometrics." Tata McGraw-Hill Education, New Delhi, 2009.
- [21]. E. Auriol and M. Warlters, M. "The marginal cost of public funds and tax reform in Africa." *Journal of Development Economics*, vol. 97(1), p. 58-72, 2012.
- [22]. E. Ferede and S. Islam. "Block grants and education expenditure: evidence from Canadian provinces." *Public Finance Review*, vol. 44(5), p. 635-659, 2015.
- [23]. E. Mattos, F. Rocha and P. Arvate. "Flypaper Effect Revisited: Evidence for Tax Collection Efficiency in Brazilian Municipalities." *Estudos Econômicos*, vol. 41(2), p. 239-267, 2011.
- [24]. E. Mattos, R. Cardim and R. Politi. "Grants and Marginal Cost of Public Funding: Empirical Evidence for Local Governments in Brazil." *Revista Brasileira de Economia*, vol. 72(4), p. 479-496, 2018.
- [25]. E. Mattos, R. Politi and A. Yamaguchi. "Grants and dispersion of local education spending in Brazil". *Regional Studies*, vol. 52(2), p. 239-249, 2017.
- [26]. F. A. B. Cossío and L. M. Carvalho. "Os efeitos expansivos das transferências intergovernamentais e transbordamentos espaciais de despesas públicas: evidências para os municípios brasileiros - 1996." *Pesquisa e Planejamento Econômico*, vol. 31(1), p. 75-124, 2001.
- [27]. F. A. B. Cossío. "Ensaio sobre federalismo fiscal no Brasil." Doctoral dissertation. PUC. Rio de Janeiro, 169p. 2002.
- [28]. F. A. B. Cossío. "Os Efeitos das Transferências Intergovernamentais: O Flypaper Effect nas Finanças Municipais Brasileiras." Doctoral dissertation, PUC, Rio de Janeiro. Chap. 3, 2006.

- [29]. F. Bastida, B. Benito and M. D. Guillamn. "An empirical assessment of the municipal financial situation in Spain." *Public Management Journal*, vol. 12(4), p. 484-499, 2009.
- [30]. F. Hayashi. "Econometrics." Princeton University Press, Princeton, 2000.
- [31]. F. J. A. Parmagnani and F. F. Rocha. "Evaluating the impact of SUS transfers on municipalities' health expenditures." Working Papers, Department of Economics, University of São Paulo (FEA-USP), 2013.
- [32]. F. M. Aragón. "Local Spending, Transfers and Costly Tax Collection." *National Tax Journal*, vol. 66(2), p. 343-370, 2013.
- [33]. H. Amusa, R. Mabunda and R. Mabuğu. "Fiscal illusion at the local sphere: an empirical test of the flypaper effect using South African municipal data." *South African Journal of Economics*, vol. 76(3), p. 443-465, 2008.
- [34]. I. Silva and S. Sumarto. "How do educational transfers affect child labour supply and expenditures? Evidence from Indonesia of impact and flypaper effects." *Oxford Development Studies*, vol. 43(4), p. 483-507, 2015.
- [35]. IBGE – Instituto Brasileiro de Geografia e Estatística. Estimativas de população enviadas ao TCU, 2019.
- [36]. IBGE – Instituto Brasileiro de Geografia e Estatística. Produto Interno Bruto Brasileiro, 2017.
- [37]. J. G. A. Correia, G. I. Diniz and R. F. R. Costa. "Analisando o comportamento dos gastos públicos nos municípios cearenses." *Revista de Políticas Públicas*, vol. 18(1), p.85-96, 2014.
- [38]. J. Hamilton, J. "The flypaper effect and the deadweight loss from taxation." *Journal of Urban Economics*, vol. 19, p. 148-155, 1986.
- [39]. J. Hines and R. Thaler. "The flypaper effect." *Journal of Economic Perspectives*, vol. 9, p. 217-226, 1995.
- [40]. J. J. Choi, D. Laibson and B. C. Madrian. "Mental Accounting in Portfolio Choice: Evidence from a Flypaper Effect." *American Economic Review*, American Economic Association, vol. 99(5), p. 2085-95, 2009.
- [41]. J. Martinez-Vazquez and A. Timofeev. "A fiscal perspective of state rescaling." *Cambridge Journal of Regions, Economy and Society*, vol. 2(1), p. 85-105, 2009.
- [42]. J. P. Cohen. "Reciprocal state and local airport spending spillovers and symmetric responses to cuts and increases in federal airport grants." *Public Finance Review*, vol. 30(1), p. 41-55, 2001.
- [43]. J. Vallés-Giménez and A. Zarate-Marco. "Tax Effort of Local Governments and its Determinants: The Spanish Case." *Annals of Economics and Finance*, vol. 18(2), p. 323-348, 2017.
- [44]. J.A. Diniz, R. H. Lima and V. G. Martins. "The effect flypaper in the funding of fundamental education of municipalities in Paraíba." *Administração Pública e Gestão Social*, vol. 9(2), p. 95-104, 2017.
- [45]. L. O. G. Ferreira, F. Revelli and A. L. M. Serrano. "The Effects of Federal Constitutional Grants in Brazilian Municipalities." *Review Urban & Regional Development*, vol. 31(3), 2019.
- [46]. M. Baekgaard and M. Kjaergaard. "Intergovernmental grants and public expenditures: evidence from a survey experiment." *Local Government Studies*, vol. 42(2), p. 189-207, 2016.
- [47]. M. Baker, A. Payne and M. Smart. "An empirical study of matching grants: The 'CAP on the CAP'." *Journal of Public Economics*, vol. 72, p. 269-288, 1999.
- [48]. M. Mendes. "Capture of fiscal transfers: a study of Brazilian local governments." *Economia Aplicada*,

- vol. 9(3), p. 427-444, 2005.
- [49]. N. Akai and M. Sakata. "Fiscal decentralization contributes to economic growth: evidence from state-level cross-section data for the United States." *Journal of Urban Economics*, vol. 52, p. 93-108, 2002.
- [50]. N. Habibi, C. Huang, D. Mirandam N, Murillo, G. Ranis, M. Sarkar and F. Stewart. "Decentralization and Human Development in Argentina." *Journal of Human Development and Capabilities*. vol. 4, p. 73-101, 2003.
- [51]. O. J. Cárdenas and A. Sharma. "Mexican Municipalities and the Flypaper Effect." *Public Budgeting & Finance*, vol. 31, p. 73-93, 2011.
- [52]. P. Acosta. "The "flypaper effect" in presence of spatial interdependence: Evidence from Argentinean municipalities." *Annals of Regional Science*, vol. 44, p. 453-466, 2010.
- [53]. P. Lloyd-Sherlock. "Simple Transfers, Complex Outcomes: The Impacts of Pensions on Poor Households in Brazil." *Development and Change*, vol. 37, p. 969-995, 2006.
- [54]. R. Kneebone and K. McKenzie. "Electoral and partisan cycles in fiscal policy: An examination of canadian provinces." *International Tax and Public Finance*, vol. 8, p. 753-774, 2001.
- [55]. R. Williams, P. D. Allison and E. Moral-Benito. "Linear Dynamic Panel-data Estimation Using Maximum Likelihood and Structural Equation Modeling." *The Stata Journal*, vol. 18(2), p. 293-326, 2018.
- [56]. S. C. Deller and C. S. Maher. "A model of asymmetries in the flypaper effect." *Publius*, vol. 36(2), p. 213-229, 2006.
- [57]. S. C. Deller and C. S. Maher. "Categorical municipal expenditures with a focus on the flypaper effect." *Public Budgeting Finance*, vol. 25(3), p. 73-90, 2005.
- [58]. S. J. Bailey and S. Connolly. "The flypaper effect: Identifying areas for further research." *Public Choice*, vol. 95, p. 335-361, 1998.
- [59]. S. N. Sakurai and N. Menezes-Filho. "Opportunistic and partisan election cycles in Brazil: new evidence at the municipal level." *Public Choice*, vol. 148, p. 233-247, 2011.
- [60]. S. N. Sakurai. "Efeitos assimétricos das transferências governamentais sobre os gastos públicos locais: evidências em painel para os municípios brasileiros." *Pesquisa e planejamento econômico – PPE*, vol. 43(2), p. 309-332, 2013.
- [61]. S. P. Bhanot, J. Han and C. Jang. "Workfare, wellbeing and consumption: evidence from a field experiment with kenya's urban poor." *Journal of Economic Behavior & Organization*, vol. 149, 372-388, 2018.
- [62]. T. A. Downes. "Does fiscal dependency matter? Aid elasticities for dependent and independent school districts." *Economics of Education Review*, vol. 19(4), p. 417-429, 2000.
- [63]. T. Baskaran. "Intergovernmental transfers, local fiscal policy, and the flypaper effect: evidence from a German state." *FinanzArchiv Public Finance Analysis*, vol. 72(1), p. 1-40, 2016.
- [64]. V. Dickson and W. Yu. "Revenue structures, the perceived price of government output, and public expenditures." *Public Finance Review*, vol. 28(1), p. 48-65, 2000.
- [65]. W. E. Oates. *Fiscal federalism*. New York: Harcourt Brace, 1972.
- [66]. Y. Acar. "Does flypaper effect exist? New evidence from turkish municipalities." *Sosyoekonomi*, vol. 27(39), p. 55-68, 2019.

- [67]. Y. Psycharis, M. Zoi and S. Iliopoulou. “Decentralization and local government fiscal autonomy: evidence from the Greek municipalities.” *Environment and Planning C: Government and Policy*, vol. 34(2), p. 262–280, 2016.

6. Appendix

IGP-DI Index

Table 6

year	Deflation Index
1985	3,417,402,846.02
1986	1,194,970,774.62
1987	409,207,452.50
1988	62,191,009.50
1989	3,964,141.28
1990	157,532.03
1991	36,403.64
1992	3,892.72
1993	162.96
1994	7.23
1995	3.63
1996	3.06
1997	2.65
1998	2.43
1999	2.28
2000	2.14
2001	2.03
2002	1.85
2003	1.56
2004	1.48
2005	1.35
2006	1.37
2007	1.26
2008	1.09
2009	1.03
2010	1.00