

Minimum Spending in Education and the Flypaper Effect

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ABSTRACT

Education funds in Brazil comprise local revenue and intergovernmental transfers. This study analyzes the importance of budget structure on government spending in education by estimating the effects of two characteristics of the fiscal arrangement: (i) a minimum spending rule, and (ii) a set of intergovernmental transfers. The minimum spending rule has increased educational spending only for municipalities that were below the minimum; for those above the minimum, we find a negative effect of the rule. Whereas our results indicate that the minimum rule has increased investments in low-spending municipalities, it has not affected spending in personnel for high-spending ones. We then analyze whether the sources of funds matter to government spending by estimating the flypaper effect of intergovernmental transfers using an instrumental variable method. We find a significant flypaper effect for redistribution transfers. Interestingly, we do not find flypaper effect for other types of intergovernmental transfers.

1. Introduction

In a decentralized education system, the understanding of how local governments use their budgets and how their budget decisions are influenced by the central government is of great importance to the design of education funding policies. In Brazil, there are two main national education funding policies that have major implications in all local budgets for basic education: (1) the conditionality of minimum use of local taxes to education, and (2) the intergovernmental transfers dedicated to education.

Intergovernmental transfers and conditionalities in the use of resources are commonly employed as a way for local governments to meet the desires of the federal government, expanding certain services, equalizing local income and ensuring minimum quality for basic services; avoiding, therefore, a need for the federal government to assume the responsibilities of local governments to guarantee a minimum quality of services (Buchanan 1963; Diniz 2012). The Brazilian spending conditionality to education refers to 25 percent of all local tax and transfer revenues, which are mandated to be spent on municipal and state public education systems. The intergovernmental transfers, in its turn, include different types of transfers from the federal or state

level governments to the municipalities.

This article analyzes the importance of budget structure on government spending in education by estimating the effects of these two characteristics of the Brazilian fiscal arrangement for education: the minimum spending rule, and the types of intergovernmental transfers. By using a rich panel of financial variables from 2005–2018 we estimate the effects of the difference between the minimum spending rule and how much the municipality was already spending in the year before. Our analysis considers whether a municipality was already above the minimum – and the rule was not binding its expenses – or if it were below the rule and had to increase spending in education in order to comply with the law.

A Constitutional Amendment Proposal currently under discussion in Brazil aims to unify the minimum spending rule in education to the health minimum amount, under the argument that such flexibility would increase the efficiency of local spending (BRASIL 2019).¹ We find that the minimum spending rule has increased educational spending over time in Brazil only for municipalities that were below the minimum; for those above the minimum, we find a negative effect of the minimum rule. Additionally, we estimate the types of spending done in response to the minimum rule, focusing on efficiency measures

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¹ Currently, Brazilian municipalities must spend 15% of its tax and transfer revenues in the health sector. The Constitutional Amendment Proposal (PEC 188/2019) combines the education and health proportions, stating that 40% of tax and transfer revenues (15% of health + 25% of education) should be spent either in education or health sectors.

of budget uses. Our results inform this debate by indicating that the minimum rule has actually improved the efficiency in spending of municipalities below the minimum, by increasing investment rates and the liquidity of municipal budgets. For municipalities above the minimum, the rule has decreased the proportion of investment and the liquidity of municipal budgets. Our results also indicate an increase in the proportion of personnel spending in response to the rule, for those below the rule. However, this proportion does not continue growing after the municipality has fulfilled the minimum rule, contradicting the commonly projected effect that expenditure rules would lead to ever-growing expenses in personnel (Hallerberg, Scartascini, and Stein 2009, chap. 3).

To analyze whether the sources of revenue matter, we estimate the local governments' education spending responses to revenues from two sources: local revenues and intergovernmental transfers. It is well-established in the literature of public finance that intergovernmental transfers lead to greater public spending than an equivalent increase in local revenue – the so-called flypaper effect (Turnbull 1998; Gordon 2004; Inman 2008). The flypaper effect is characterized by a greater adherence of intergovernmental transfers than one would expect if the public manager were to maximize the preferences of the representative elector. As we consider the specificities of the Brazilian education financing policies, we analyze how the existing theoretical explanations for the flypaper effect in the public finance literature explain the effects of intergovernmental transfers on education spending in the conditions of different spending requirements.

The Brazilian case is an informative example of both a minimum spending requirement on the local revenue and of intergovernmental transfers earmarked to different types of education expenditures. The existence of intergovernmental transfers with different characteristics – such as the transfers done by agreements (FNDE transfers) and the redistribution transfers (done via FUNDEB)² – allows for the empirical analysis of the flypaper effect with different types of intergovernmental transfers. Thus, this article not only enters the debate of the flypaper effect but mainly it adds to the discussion about budget structure and spending conditionalities in a federative context.

A critical concern in the empirical analysis of flypaper effects is whether the elasticity of spending to changes in intergovernmental transfers is overestimated by the existence of unobserved municipal characteristics that affect both the amount received by intergovernmental transfers and the government's spending decisions. In order to reliably estimate the exogenous variation in intergovernmental transfers, we use an instrumental variable (IV) approach to estimate the amount of redistribution transfers received by each municipality that is solely explained by the relative number of enrolled students in basic education in the prior year.³

We estimate the elasticities of education expenses to revenues from different sources limiting the analysis for those municipalities that are not bound by the minimum spending restrictions. That is, we analyze the elasticity of government spending of fungible funds, even though part of the budget is non-fungible. We find that the flypaper effect is of great importance to the increases in educational expenses observed in Brazil between 2005 and 2018. However, we only find this effect for the transfers coming from redistribution funds – the elasticity of education

expenses to federal transfers done via agreements is similar to the elasticity to local resources. This result is similar to assert that the elasticity of education expenses to redistribution transfers is much greater than the elasticity of expenses to transfers done by one-to-one agreements, even though the agreements' transfers are also inter-governmental transfers from the federal to local governments. The greater elasticity of redistribution transfers suggest that voters are less aware of the amount of transfers coming from FUNDEB, and therefore increases in such transfers lead to higher increases in education expenses than other types of revenues. Moreover, it indicates that mayors and voters take the funds coming from agreements as being similar to local resources.

The study is divided in six sections, including this introduction. Section 2 briefly presents the context of Brazilian education financing. In the Section 3, we describe the data. Section 4 discusses our empirical strategy, dividing the analysis by the minimum spending rule and flypaper effect, and the Section 5 presents the results. Finally, in Section 6 we draw the conclusions of this study.

2. Context

2.1. Education Financing in Brazil

The 1988 Brazilian Federal Constitution established that all states, municipalities, and the federal government should invest a fixed portion of their tax revenues and transfers in the 'maintenance and development of education' of the public education system (BRASIL 1988).⁴ Such portion (henceforward called as the "constitutional minimum") amounts to 25% for states and municipalities, and to 18% for the federal government, and the spending on any educational level, from kindergarten to higher education, would count toward this fixed portion. A new Constitutional Amendment Proposal (PEC 188/2019) is under discussion in Brazil, proposing a combined minimum spending rule, for education and health sectors altogether (BRASIL 2019).

The values of the minimum have no specific meaning in terms of costs of education. Some authors argue that they were close to what municipalities, states and the federal government were already spending in 1988, and was set as a target of spending (Menezes 2008). Two situations are relevant when a compulsory minimum expense in education is defined. First, the conditioned minimum may be greater than the expense previously incurred. In this case, the rule leads to an increase in expenses by the amount necessary to achieve the minimum. Second, the minimum spending value does not change the total spending, as the budget is already higher than the minimum.

In Figure 1 we show, per municipality, the ratio of expenses in the maintenance and development of education and tax collection (in the vertical axis), and the ln of 25% of tax collection (which is the constitutional minimum, in the horizontal axis). As we see, almost all municipalities met the constitutional minimum between 2008⁵ and 2018, less than 1% of municipalities did not comply with the rule. We can also note that, in general, municipalities spend in maintenance and development of education between 25% and 35% of their tax revenue. In addition, we observe higher shares of expenses in education for municipalities with lower tax revenues, and lower shares in municipalities with higher tax revenues, although the dispersion is also higher for lower levels of tax revenue.

² In Portuguese, FNDE stands for *Fundo Nacional de Desenvolvimento da Educação* and FUNDEB stands for *Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação*.

³ We have also analyzed whether the amount of transfers coming from agreements is influenced by the political alignment of the mayors' coalition with the federal government, and the number of Congress members from the municipalities elected as possible instruments for the amount of transfers received via agreements (Bracco et al. 2015; Brollo and Nannicini 2012; Feld and Schaltegger 2005; Veiga and Pinho 2007). We did not find any significant relationship between these political measures and the amount of intergovernmental transfers received by agreements.

⁴ "Maintenance and development of education" (MDE) is a concept that was defined by the Brazilian law n. 9.394 (BRASIL 1996). This law determines what types of expenses can be considered as maintenance and development of education. The 25% constitutional minimum spending must be spent on any type of expenses defined by the 1996 law.

⁵ As discussed in the Data Section, the information on MDE expenditure is unavailable for years prior to 2008.

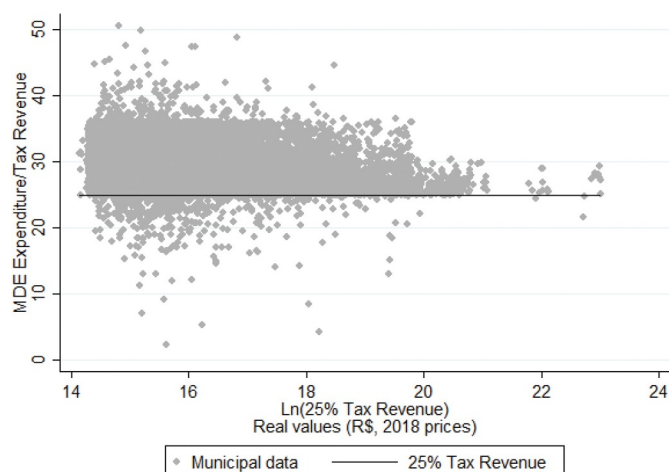


Figure 1. Education Spending as a Proportion of Tax Revenue and the Constitutional Minimum by Municipalities, 2008 - 2018.

Source: FNDE/SIOPE, Brazilian Ministry of Education. Prices data are from FGV. Authors' elaboration.

Brazil adopts one of the most remarkable systems of conditioned subsidies for education in the world (Shah 2006). Despite being considered by many as a huge gain for education, this constitutional requirement did not deal with the existing asymmetries in per student expenses among public schools around the country, since the wealthiest municipalities and states had more to spend per student than the poorest ones (Menezes-Filho and Pazello 2007; Cruz 2018). In response to such inequalities, the federal government announced a reform of the funding model for the public primary school system, called FUNDEF, to be implemented as of January 1st 1998 for a period of 10 years, which was in force between 1998-2006.⁶

In order to renew FUNDEF, FUNDEB was created. FUNDEB is also a group of state Funds⁷ of accounting nature formed by resources originated from taxes and transfers tied to education from the states, the Federal District and the municipalities (20 percent of specific local taxes and transfers), as well as having an additional financial portion originated from federal resources. Regardless of the source of origin, all resources raised by the 27 Funds are redistributed for exclusive use in basic education. Resources are redistributed within the scope of each state among the governmental entities located in each territory (state and municipal governments). There is no movement of resources from one state to another. All funds transferred through FUNDEF-FUNDEB must be spent exclusively in maintenance and development of education (MDE). FUNDEF-FUNDEB also established that each system should dedicate at least 60% of the Fund's budget to salaries of professionals working in basic education (BRASIL 2008).

The Brazilian federal government is the main responsible for the higher education system and the municipal and state revenues are the main funders of basic education. Nevertheless, 33.5% of federal expenditures for 2018 on education were directed toward basic education. Most of the intergovernmental transfers in basic education from the federal to the local governments in Brazil are done through a federal authority attached to the Brazilian Ministry of Education, called FNDE (Cruz 2011). The FNDE transfers are dedicated to several education programs coordinated by the federal government, including the federal resources to the FUNDEB.

FNDE's financing policy takes effect in three modalities: (i) direct, (ii) automatic, and (iii) voluntary. Direct transfers occur mainly

through the distribution of goods, such as textbooks for example (BRASIL 2018). The largest amount of FNDE's resources is transferred by automatic transfers. The main characteristic of automatic transfers is the lack of an agreement between the federal and local governments. Automatic transfers may be constitutional (such as the FUNDEF transfers and the "education-salary"⁸), legal transfers (such as the "National School Feeding Program" (BRASIL 2009)), or discretionary (arising from the "Articulated Action Plan" or other FNDE initiatives).⁹ Voluntary transfers are usually not envisaged by law and involves the signing of agreements. Although the FUNDEF-FUNDEB transfers from the federal government are done through the FNDE automatic transfers, most of its funds comes from the redistribution within the states. Therefore, when we are analyzing the agreements' transfers, we are referring to all FNDE transfers (including other automatic FNDE transfers, such as funds transferred directly to schools¹⁰) that are not going to the redistribution Funds.

Figure 2 presents the descriptive statistics from 2005 to 2018 of the municipal *per capita* expenses in education, the local revenues, the redistribution (FUNDEF-FUNDEB) and other transfers done by agreements (FNDE transfers). As we see, all monetary *per capita* variables used in our analysis present a real increase in the period studied. In 2018, the yearly average expenses of municipalities per inhabitant was R\$ 945.02 (the equivalent of US\$ 258.91 with an exchange rate of R\$ 3.65 per dollar), the mean FUNDEB revenue was R\$ 531.59, the mean FNDE revenue was R\$ 72.12, and the mean local revenue was R\$ 226.43. As we see, the mean values of FUNDEB transfers are significantly higher than the mean local revenues *per capita*.

The total tax revenue budget (local revenues + constitutional transfers) of Brazilian municipalities was R\$ 356 billion in 2018. Only a small proportion of this total is comprised by local revenue (R\$ 131 billion). As described above, part of the constitutional transfers revenue goes to the redistribution state Funds to be redistributed across the municipal and state systems. Therefore, the constitutional minimum spending in education represents 25% of the local (non-FUNDEB) revenue and other constitutional transfers, plus the FUNDEB transfers.

The redistribution transfers totaled R\$ 84 billion for all municipalities in 2018. It is interesting to note that the FUNDEB budget for all municipalities (R\$ 84 billion) is smaller than the local revenue budget for all municipalities (R\$ 525 billion), even though the mean municipal value *per capita* is much higher for the FUNDEB transfers compared to the mean municipal local revenue *per capita*. This difference suggests a very unequal distribution of tax collection across municipalities, and an important role of the FUNDEB redistributions in equalizing funds across municipalities. In other words, the redistribution of FUNDEB funds increases the mean values transferred to the municipalities, even though the overall FUNDEB budget is lower.

2.2. The Flypaper Effect in Brazil

According to Inman (2008) "the flypaper effect results when a dollar of exogenous grants-in-aid leads to significantly greater public spending

⁸ The "education-salary" ("salário-educação") is a social contribution to finance public basic education. It represents 2.5% of the total personnel remuneration paid or credited by companies. Companies and entities (public and private) linked to the Social Security System are contributors of the "education-salary". FNDE is responsible for its redistribution, which is divided into a federal quota that is applied to financing basic education programs and state and municipal quotas that are redistributed between the states and their municipalities, in proportion to the number of students enrolled in basic education in the system (BRASIL 1988, 2003b).

⁹ For further information, check: Portal do FNDE (BRASIL, n.d.).

¹⁰ The program "Dinheiro Direto na Escola" transfers federal funds directly to schools that fulfill certain characteristics according to the programs subscribed by each school (depending on the program, the municipality may be responsible for the subscription).

⁶ FUNDEF stands for "Fund for the Maintenance and Development of Fundamental Education and the Valorization of Education Professionals" (BRASIL, 2003a).

⁷ One Fund per state plus the Federal District, totaling twenty-seven Funds.

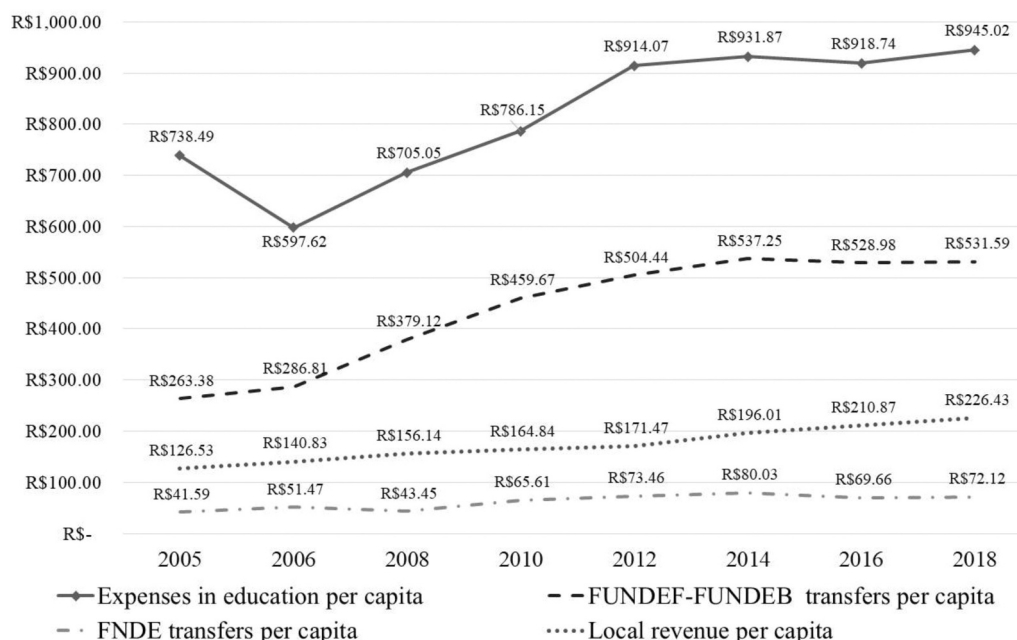


Figure 2. Mean Revenues and Expenses in education, *per capita*.

Sources: FNDE\SIOPE & FGV, 2005-2018. Prices 2018=100. Mean municipal values. We use a balanced panel with 5,562 municipalities. The missing data were imputed by a regression analysis.

than an equivalent dollar of citizen income: Money sticks where it hits.” As presented by Inman (2008), if we consider the government as an agent for the representative citizen voter, this empirical result is an anomaly. However, if we consider the existing political institutions (in this case, Inman's object of study is the United States), the flypaper effect is not an irregularity, but an effect of the incentives associated with the elected managers. Gordon (2004), for instance, shows that, over time, US federal funds originating from *Title I* (resources aimed at improving educational outcomes for disadvantaged students) are offset by a decrease in spending on other local funds that previously were to be used for disadvantaged students. Gordon (2004) suggests that in the first year of a further increase in federal subsidies, funds tend to “adhere” to the intended purpose, but this effect disappears over time.

Several authors have observed the presence of flypaper effects in Brazil (Almeida and Ribeiro 2016; Schettini 2012; Linhares, Simonassi, and Nojosa 2012). Almeida and Ribeiro (2016) estimate the effect of an increase in transfers of the Municipal Participation Fund,¹¹ of the Circulation of goods and services Tax,¹² and of Municipal Gross Domestic Product on municipal expenditures. The authors find the typical flypaper effects; that federal transfers have bigger effects on spending than state transfers, which in their turn have bigger effects than local income.

Schettini (2012) uses panel VAR methodology with data from total expenditures, tax revenues and intergovernmental transfers of all

Brazilian municipalities from 2002 to 2010 and also finds evidence of a flypaper effect. According to Schettini (2012), municipal governments accommodate their expenses to the local tax collection, so the intergovernmental transfers add to the expenses (indicating the existence of flypaper effects). In turn, tax revenues do not react to shocks in spending. Such results suggest that when faced with budget imbalances, municipalities adjust the expenses, rather than the tax collection. Linhares et al. (2012) analyze the revenues, transfers and government spending of Brazilian municipalities before and after the 2000 Fiscal Responsibility Law (BRASIL 2000). They find the existence of flypaper effects in both periods, although – differently from Schettini (2012) – their estimates suggest that there is fiscal synchronism between taxation and public expenditures after the Fiscal Responsibility Law.

In contrast, the studies of Mattos et al. (2011) and Diniz et al. (2017) use a different concept of flypaper – as the differential effect that revenues coming from different sources have in affecting the efficiency of local governments. According to this concept, higher transfers from the federal government lead to lower efficiency compared to increases in private income. The two studies find a negative relationship between revenues coming from intergovernmental transfers and an efficiency index (the authors use different efficiency measures). Moreover, they find a positive relationship between local revenue and efficiency. In specific, Diniz et al. (2017) analyze the FUNDEB intergovernmental transfers, and find that those municipalities that received more funds from the FUNDEB redistribution than how much they gave to the FUNDEB State Fund had lower efficiency scores. In Appendix A, we discuss the theoretical model for our empirical analysis, describing further the flypaper effect in the Brazilian education context.

3. Data

We use annual data collected between 2005 and 2018 regarding municipal *per capita* revenues and paid expenses specific to education.¹³ The specific information on the proportion of spending on maintenance and development of education (MDE) is only available starting in 2008.

¹¹ The Municipal Participation Fund (in Portuguese, *Fundo de Participação Municipal*, or FPM), is the main way the Brazilian federal government transfers funds to municipalities, in amounts mainly determined by the proportion of the total Brazilian population living in the municipality, estimated annually by the Population Census from IBGE.

¹² The Circulation of goods and services Tax (in Portuguese, *Imposto sobre Circulação de Mercadorias e Serviços*, or ICMS) refers to taxes collected by the Brazilian states from any person or entity that performs operations of the circulation of goods, communication services or services of interstate and intermunicipal transportation, at a commercial level of frequency or volume. The states are required to distribute to their respective municipalities 25% of the collected value (on top of the 15% that is transferred through the FUNDEF-FUNDEB transfers).

¹³ We use paid expenses (*despesas pagas*) instead of committed expenses.

However, since most of our analysis compares the total revenue to education and the total expenditure (not only MDE expenses), we are able to do the analysis from 2005 to 2018. Monetary data are from the Public Education Budgeting Information System (SIOPE), of the National Fund for the Development of Education (FNDE) (BRASIL n.d.).¹⁴

It is important to note that we estimate the effect of a minimum spending rule when the policy is already well-established; it does not refer to the effect of creating such policy. It is not possible to evaluate the effect of the minimum spending rule in its start, because the existing data goes back only to 2005. Also, this period of analysis includes both an economic growth and a public financial crisis (Manna 2018; Pereira 2017); therefore, our results represent the average effect during these periods.

The municipality's total revenue refers to the sum of current and capital revenues. Municipal revenues earmarked for education include: (i) 25% of local tax revenue¹⁵; (ii) 25% of revenues from intergovernmental transfers originated from taxes (other than FUNDEB); (iii) revenue from transfers from the National Fund for the Development of Education (FNDE); (iv) the municipal balance from the Fund for the Maintenance and Development of Basic Education and Valorization of Education Professionals (FUNDEB)¹⁶; (v) 5% of the taxes and transfers that are part of FUNDEB but were not part of the redistribution; and (vi) other revenues earmarked to education.¹⁷ Local municipal tax revenue, FUNDEB and FNDE revenues were used separately in our estimations. The total expenses in education were also estimated using the sum of total current and capital expenses to education according to the SIOPE database.

We use the municipal estimated population information provided annually by the Brazilian Institute of Geography and Statistics (IBGE) in the calculation of *per capita* variables.¹⁸ To deflate the monetary series we use the price index IGP-DI, produced and released by the Getulio Vargas Foundation (FGV). IGP-DI price index was chosen because it covers the sectors of services provided to families, construction industries and retail trade, thus encompassing the different agents of the school community.

In addition, we use: (i) the political party of the mayor elected informed by the Electoral High Court (TSE, n.d.), (ii) the *per capita* sum of municipal expenses in the education of the neighboring municipalities weighted by the distance between each municipality, (iii) three different measures of spending' efficiency provided by the FIRJAN system¹⁹ and calculated using SIOPE data, (iv) the municipal basic

education enrollment provided in the Census of Basic Education by INEP,²⁰ and (v) the fulfillment of the Fiscal Responsibility Law about the maximum proportion of municipal personnel spending over net current revenue, calculated using FINBRA data.²¹ The distance between the municipalities was calculated by the geodesic distance of latitude and longitude of the cities (from the National Census, IBGE).²² The political party of the mayor who wins the election was considered to be the party of the mayor in the following three years, unless there was a new election. Bracco et al. (2015) presents the importance of a political alignment with the federal party in receiving federal transfers. We use information of candidates elected in first or second turn in regular and supplemental municipal elections from the Electoral High Court. We also use IBGE municipal information for mayors' political party.²³ Municipal elections happen every four years, therefore, we use the information of mayors' party in the 2004, 2008, 2012 and 2016 elections. On these four elections, thirty-seven parties command Brazilian municipalities and PMDB party won most municipal elections.²⁴

The three efficiency measures of municipal public spending used in the analyses were indexes going from zero to one of: (I) investments, (II) liquidity, and (III) personnel proportion. These three measures were calculated as following: (I) Investment %: Proportion of investment spending (capital and financial investments expenditures in education) over net current revenue (current revenue minus deductions); (II) Liquidity index: Difference between cash availability and deferrals of expenses,²⁵ relative to net current revenue (it is part of the FIRJAN Fiscal Management Index (IFGF 2017)²⁶); and (III) Personnel %: Personnel spending in education over the net current revenue. We use SIOPE data to calculate Investment % and Personnel % indexes.²⁷

We treat as missing values the 3,444 outlier cases found in different variables over the 14 years of the analysis. We estimate outliers for monetary variables – education expenses, and revenues (total education revenue, local revenue, FNDE revenue and FUNDEF-FUNDEB revenue) – and for efficiency data (investments, liquidity and personnel indexes).²⁸ Further, we treat as missing values the six data points equal to zero in FNDE and FUNDEF-FUNDEB revenues. The missing data are then imputed using a linear regression methodology on the mesoregion and the mayor's party on the year, so the results can be expanded to all Brazilian municipalities. Subsequently, with a balanced panel we keep our data to 5,562 municipalities from 2005 to 2018 summing to 77,868 observations.

We divide the 5,562 municipalities between those that in year $t-1$ have spent in education more (or less) than the obligatory minimum in year t . For the minimum spending estimation, the data is from 2007 to 2018 (66,740 observations), since we use *per capita* education spending

¹⁴ The Brazilian paid municipal expenditures are reported to Brazilian Finances (FINBRA) and Public Education Budgeting Information System (SIOPE). We decided to use the second source because it presents information since 2005, while the first only since 2013.

¹⁵ Local tax revenue corresponds to the sum of tax revenues, tax arrears and interests, interest and arrears on the active tax debts.

¹⁶ The municipal balance from the FUNDEB is comprised of the sum of taxes and transfers, the supplementation by the Federal government, minus the deductions in municipal shares of state and federal taxes. As shown above, FUNDEB started in 2007. Prior to 2007, FUNDEF was in force, which is also a fund for the redistribution of resources destined to Education, but restricted to Elementary Education and included transfers from fewer taxes.

¹⁷ Other revenues earmarked to education include (i) current revenues originated from transfers from states, from abroad as well as from private and personal transfers, (ii) current revenues of transfers by additional agreements between the federal government, the states and municipalities, (iii) capital revenues from external and internal credit operations, (iv) capital revenues originated from transfers of the Federal government, the states, and municipalities, from abroad as well as from private and personal transfers, and (v) capital revenues from transfers by the agreement between the Federal government, the states and municipalities.

¹⁸ The 2010 population data was provided by the Demographic Census (IBGE 2010).

¹⁹ The FIRJAN System is a private non-profit organization that aims to promote business competitiveness, education and quality of life of the industry worker. (FIRJAN, n.d.).

²⁰ INEP stands for *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*, from the Brazilian Ministry of Education.

²¹ We use committed personnel spending (*despesas empenhadas*) to calculate the proportion of overall personnel spending.

²² The geodesic distance calculates the length of the shortest curve between two points along the surface of a mathematical model of the earth.

²³ In 0.07% of municipal elections, the Electoral High Court data for mayors was not reported.

²⁴ We have also used data from the Electoral High Court for the municipality and microregion where Congress members were elected, in the analysis of possible political influences in the amount of funds received by municipalities by agreements.

²⁵ The 'deferrals of expenses' are expenses hired but not paid in the year (In Portuguese, they refer to "*restos a pagar*").

²⁶ The FIRJAN index was built using the municipalities' fiscal results – of annual mandatory declaration. It started to be accounted in 2006. Source: National Treasury Secretariat.

²⁷ We have discarded the data of three municipalities, which presented education expenditures greater than total revenue.

²⁸ We use the methodology proposed by Hidioglou and Berthelot (1986), but considering two growth rates of an observation, one compared with the data in the year before and the other with the year after.

two years lag as covariate. We drop 448 observations to transform variables into logarithm, in cases when variables are smaller than one. Therefore, we have 45,366 municipalities above the minimum from one year to another and 20,930 below the minimum. This is our sample in estimation (1), as presented in Tables (1) and (2). For the flypaper estimation, we find 50,672 cases where the municipality was already spending in $t-1$ (from 2005 to 2017) more than the minimum *per capita* in year t (from 2006 to 2018). In addition, we also drop 47 observations to transform variables into logarithm, in cases when variables are smaller than one. Therefore, we have 50,625 observations in our sample in estimations (2) and (3), as presented in Tables (3) and (4).

4. Empirical Strategy

4.1. Minimum Spending

What are the effects of a minimum spending rule on educational expenses? Several Brazilian municipal revenues are mandatorily earmarked for education – such as 25% of all taxes and transfers (the constitutional minimum), all redistribution transfers, and other revenues coming from intergovernmental transfers. The sum of these revenues earmarked to education is, therefore, the minimum expenses in education in the municipality.

In order to estimate whether the rule on minimum spending affects overall spending in education, we estimate a panel regression model with municipal and time fixed effects, and a rich set of control variables, as presented in equation (1). In this model, we analyze the effect of the difference between how much the municipality is already spending and the minimum rule. That is, how much the municipality must increase spending to comply with the law or, if the municipality is already spending more than the minimum, how much more from the rule the municipality is already spending.

$$\begin{aligned} \ln(g_{it}) = & \beta_0 + \beta_1 \ln(|\Delta_{it}|) + \beta_2 \ln(g_{it-2}) + \beta_3 \ln(\text{Revenue})_{it-1} \\ & + \beta_4 \text{Investment } \%_{it} \\ & + \beta_5 \text{Liquidity index}_{it} + \beta_6 \text{Personnel } \%_{it-1} + \beta_7 D(\text{Personnel Law})_{it-1} \\ & + \beta_8 \ln(E_{it}) \\ & + \beta_9 \ln(E_{it-1}) + \beta_{10} P_{it} + \beta_{11} DI_{it} + \beta_i + \beta_t + \varepsilon_{it} \end{aligned} \quad (1)$$

Where $\Delta_{it} = (\min \text{ spend}_{it} - g_{it-1}) > 0$ or $\Delta_{it} = (\min \text{ spend}_{it} - g_{it-1}) < 0$

In this model, the variable $\ln(g_{it})$ refers to the \ln of the *per capita* expense in education of municipality i in year t . The variable $\ln(|\Delta_{it}|)$ is the \ln of the difference between the *per capita* minimum spending rule in education and the *per capita* spending in education in the year before.²⁹ If this difference is positive, it means that the municipality is below the minimum rule (considering its expenses in the year before) and, therefore, must increase spending in education in year t . If Δ is negative, it means that the municipality was already spending in year $t-1$ the total minimum required in year t . Therefore, it is not required any increase in spending. Since a change is required when Δ is positive, but no change is needed when Δ is negative, we will estimate two separate regressions for these two cases.

How much one municipality is spending in year $t-1$ is likely an important determinant of how much it would spend in the next year. Since our objective is to understand the impact of the minimum

spending rule on the actual education spending, we need to separate the effect of how distant each municipality i is from the rule. Therefore, we control for the past *per capita* spending of the municipality ($\ln(g_{it-2})$), and for past total *per capita* revenue received for education.

The Fiscal Responsibility Law determines that municipalities must not spend more than 60% of its current net revenue in personnel (BRASIL 2000). One may expect that municipalities above this level have a greater incentive to decrease spending in teachers, for example, which may have a significant impact in educational expenses. In fact, research has shown that municipalities who were spending more than 60% of its net current revenue have decreased expenses in personnel to comply with the law; however, the overall effect of the Fiscal Responsibility Law was to increase workforce costs – as most of the municipalities were below the maximum proportion determined by law (Giuberti 2005; Menezes 2006).³⁰ Therefore, we include in our model a control variable for the proportion of personnel spending relative to the net current revenue in the year before ($\text{Personnel } \%_{it-1}$). Additionally, one may worry that the effect of being above the maximum of the Fiscal Responsibility Law is related to the effect of the minimum spending in education. In order to deal with this possibility, we have also included a dummy variable for being above or below the personnel maximum in year $t-1$ ($D(\text{Personnel Law})_{it-1}$).³¹

Our estimations include municipal and time fixed effects (β_i and β_t , respectively). As covariates, we also include P_{it} as dummies for the mayor's party of the municipality i in year t (for each mandate); efficiency indexes, referring to management efficiency proxies (particularly *Investment* $\%_{it}$ and *Liquidity index* $_{it}$); and $\ln(E_{it})$ and $\ln(E_{it-1})$ referring to the \ln of student enrollment in basic education in years t and $t-1$. Standard errors are clustered at the mesoregion level,³² as we believe that errors may be correlated across some municipalities with similar socioeconomic characteristics.

The variable DI_{it} refers to the sum of the *per capita* expenses of neighboring municipalities weighted by the distance of each municipality i in year t to all other municipalities of the sample. Municipal expenses can be influenced by the expenses of their neighbors, both by an increase in the income of the region in which municipality i is located and by an “imitation” effect, as pointed out by Almeida and Ribeiro (2016) and Baicker (2005). Voters can change their demands towards the municipal manager by observing what is being done in the surrounding municipalities, with the distance between municipalities indicating the importance of that influence. For instance, if the municipality next to a municipality i increases its public spending on education, and there is an improvement in the quality of schools, voters in municipality i may demand increases in education expenses, even if there has not been an increase in local income. On the other hand, an increase in expenses in surrounding municipalities of municipality i may decrease the spending of municipality i by a decrease in the demand for education services. For example, an improvement in the

³⁰ Some authors have theorized that municipalities would comply with the Fiscal Responsibility Law by changing the types of contracts of public servants, or hiring workers via third-party contracts. Even though public workers with third-party contracts were also accounted in the total personnel costs, third-party contracts could be unduly accounted as non-personnel costs (more easily than wrongly classifying public servants as non-personnel costs). However, the empirical evidence does not indicate that the Fiscal Responsibility Law has in fact increased the number of third-party contracts in Brazilian municipalities (Maia 2018).

³¹ We have also estimated regression (1) only for those municipalities that are in $t-1$ above the minimum spending in education of t , and have disrespected the maximum of personnel spending in $t-1$. Results are similar to those of the complete sample (not shown, available upon request).

³² The mesoregions are a partition of the Brazilian territory in regions that congregate several municipalities with economic and social similarities in the states. It was created by IBGE (IBGE n.d.) and is used for statistical purposes only.

²⁹ We have also estimated this difference considering the minimum spending due to the “Constitutional Minimum” only. That is, instead of considering the difference between spending in the year before to the total minimum for a municipality to spend in education, we have calculated the difference between spending in the year before and 25% of revenues from taxes and specific transfers (the quotas). The results (not shown, available upon request) are the same as we find in this analysis.

education quality of a neighbor municipality may attract students to the neighbor municipality, leading to a decrease in education spending of municipality i .

4.1.a. Minimum Spending and Efficiency

An additional question that comes along with the analysis of the effects of the minimum spending rule is what are the effects of a minimum spending rule on the efficiency of spending (Buchanan 1963; Teja 1988). If the minimum spending rule increases or decreases spending, does such variation in spending in response to the rule affect efficiency of spending? In order to answer this question, we estimate equation (1) with different efficiency measures as our outcomes. Particularly, we analyze whether being above or below the minimum spending rule (as measured by $\ln(|\Delta_{it}|)$) affects: (I) the Investment %; (II) the Liquidity index; and (III) the Personnel %.³³

The Investment % measures the share of educational investments in municipal budgets; the higher is the investment proportion, the more the municipality is using its revenue to build schools or other educational investments in the municipality that may have long-term benefits for the city. The liquidity index measures the difference between cash availability and deferrals of expenses, weighted by the size of the city's budget; the higher the index, the less the municipality is postponing payments for the following year without the proper coverage. Finally, the personnel proportion refers to the proportion of education personnel spending relative to the net current revenue.

While the first two indexes refer to more efficient uses of revenue; as the proportion in personnel' expenses grows, less space the government has to spend in other expenses, which can be considered an inefficient budget allocation (IFGF 2019). Characterizing higher spending in personnel as inefficient should be read here strictly as a fiscal assertion – given the rigidity of the personnel expenses, with long-term repercussion on retirement costs. It does not consider the importance of teacher salaries for educational quality, and the effects of well-paid teachers on student results.³⁴

4.2. The Flypaper Effect

While the flypaper effect is a well-established phenomenon of public finance, it is not clear whether we observe higher elasticity of education expenses to intergovernmental transfers when part of the local revenues is non-fungible. That is, we are interested in understanding what happens to the flypaper effect when there is a spending conditionality on local taxes – as is the case for the Brazilian constitutional minimum spending on education.

Moreover, we are interested in analyzing the responses of municipal governments to different types of intergovernmental transfers, earmarked to education. As discussed in Appendix A, if voters have different information about various types of intergovernmental grants (represented by the term θ in Eq. (A.10)), then the elasticity of government spending to changes in these intergovernmental transfers also vary.

A major concern on the estimation of the flypaper effect is whether the difference in elasticities of spending (represented by ∂ in Eq. (A.11)) is being overestimated. That is, whether the differential elasticity of government spending to intergovernmental grants relative to the elasticity of government spending to local revenue reflects an endogenous relationship between receiving intergovernmental transfers and spending in education.

Several authors argue that political alignment is a crucial

determinant of the amount of funds received by local government (Bracco et al. 2015; Brollo and Nannicini 2012; Feld and Schaltegger 2005; Veiga and Pinho 2007). Using Brazilian data of electoral terms from 1997 to 2010, Brollo and Nannicini (2012) find, for example, that municipalities with a mayor affiliated with the coalition of the president receive about one-third larger discretionary transfers for infrastructure during the last two years of the mayoral term. If being affiliated with the president coalition also facilitates greater spending in infrastructure, the higher elasticity of spending to intergovernmental transfers is not in fact showing a higher response from the government, but rather the effects of a political alignment.

This possibility could be due to the fact that mayors' preference for higher government spending is related to its political ability to receive intergovernmental transfers. To check for this possibility, we have estimated whether the amount of intergovernmental transfers received by the municipal governments' increases whenever the mayor's coalition is aligned with the president's political party – we consider that there is an alignment whenever the mayor's coalition includes the president's party. We did not find any statistical significant relationship between mayor's alignment with the president and the amount of funds received through the agreements transfers.³⁵ We have also estimated whether the number of deputies elected from each municipality or microregion has increased the amount of funds to education received from agreement transfers and did not find a significant relationship. We control for the mayors' political party in all of our estimations.

In addition to the transfers coming from local agreements to the federal government, one may worry that municipal governments may increase student enrollment in order to receive higher redistribution transfers. This may be due to the fact that the amount of FUNDEF-FUNDEB funds received by each government entity is determined by the number of students in each municipality relative to the number of students in the state. Cruz (2018) argues that municipalities that have received lower net FUNDEF transfers have increased the number of enrolled students. This possibility can be problematic if municipalities that are more successful in increasing enrollment have greater preference for higher education expenses.

Even though student enrollment in Brazil is much less of bargaining chip today than during the FUNDEF period, it is still the only possibility that mayors have to increase its redistribution transfers. Other than increasing student enrollment, the amount of funds received by each municipality is exogenously determined by the tax collection of all government entities in the state. In order to deal with this possibility – of an endogenous increase in funds to changes in student enrollment – we use an instrumental variable (IV) approach to estimate the amount of redistribution transfers received by each municipality that is explained by the relative position of student enrollment in the previous year (the number of students enrolled in basic education in the year before relative to the state's enrollment). In addition of being strongly related to the amount of redistribution funds received, a relatively small municipality in one state may be a relatively large municipality in another. Therefore, this instrument allows for a reliably exogenous variation in the amount of funds received through FUNDEF-FUNDEB transfers.

Equation (2) shows the naïve model, without the instrumental variable, and equation (3) shows our preferred model, using the relative student enrollment in the year before as an instrumental variable for the redistribution transfers. In both models, i refers to municipalities and t to years. The estimations are restricted to those municipalities where the government education spending in year $t-1$ is greater than the total mandatory spending on education in year t , as determined by the constitutional minimum and the intergovernmental grants earmarked to education.³⁶ This restriction indicates that we are only

³³ These efficiency measures were included as control variables in equation (1).

³⁴ There is a growing literature suggesting that teachers are the most important factor to develop student learning (Nye, Konstantopoulos, and Hedges 2004; Rockoff 2004).

³⁵ During a great part of the period under study (2005 to 2016), the president's party was PT (Workers' Party).

analyzing the effect of fungible money, since government spending in education is not forced to increase in order to fulfill the mandatory minimum spending determined by the constitutional minimum and the intergovernmental transfers labeled to education.

Another important aspect of our models is the inclusion of several control variables to deal with potential endogeneities. First, we include a control variable of expenses for other Brazilian municipalities, weighted by the distance in relation to the municipality under analysis. We also include two management efficiency controls: the proportion of public investment, and budget liquidity. The importance of including such efficiency measures is to control for the municipalities' intrinsic characteristics in terms of management ability (or preferences). For example, municipalities that are more efficient in managing resources may decide to spend FUNDEF-FUNDEB resources differently from local resources. If such choices on how to administer the resources is related to the amount received from local and/or intergovernmental transfers, our results could be biased by the managers' ability (rather than representing the flypaper effect). The inclusion of manager's efficiency variables controls for this possibility.

$$\begin{aligned} \ln(g_{it}) = & \beta_0 + \beta_1 \ln(\text{Redistrib trans}_{it}) + \beta_2 \ln(\text{Agreem trans}_{it}) \\ & + \beta_3 \ln(y_{it}) + \beta_4 P_{it} + \beta_5 DI_{it} \\ & + \beta_6 \text{Investment \%}_{it} + \beta_7 \text{Liquidity index}_{it} + \beta_8 \ln(E_{it}) + \beta_9 \ln(E_{it-1}) + \varepsilon_{it} \end{aligned} \quad (2)$$

For $g_{it-1} > \min \text{ spend}_{it}$

In this model, the variable $\ln(g_{it})$ refers to the \ln of the *per capita* expense in education of municipality i in year t , and $\ln(y_{it})$ is the \ln of the *per capita* local revenue of municipality i in year t . The intergovernmental transfers are divided in two categories: (i) federal transfers from local agreements (FNDE transfers), and (ii) redistribution (FUNDEF-FUNDEB) transfers. The variables $\ln(\text{Agreem trans}_{it})$ and $\ln(\text{Redistrib trans}_{it})$ refer to the \ln of the *per capita* intergovernmental transfers in municipality i and year t of these types of intergovernmental transfers, respectively. β_i is the fixed effect of municipality i , and β_t is the time fixed effect. As covariates, we have P_{it} as dummies for the mayor's party of the of municipality i in year t (for each mandate); $\text{Investment \%}_{it}$ and $\text{Liquidity index}_{it}$ referring to management efficiency proxies; $\ln(E_{it})$ and $\ln(E_{it-1})$ referring to the \ln of student enrollment in basic education in t and $t-1$; and DI_{it} , the sum of the *per capita* expenses of neighboring municipalities weighted by the distance of each municipality. Standard errors are also clustered at the mesoregion level.

First-stage:

$$\begin{aligned} \ln(\text{Redistrib trans}_{it}) = & \mu_0 + \mu_1 \frac{E_{it-1}}{\sum_j E_{it-1}} + \mu_2 \ln(\text{Agreem trans}_{it}) \\ & + \mu_3 \ln(y_{it}) + \mu_4 P_{it} + \mu_5 DI_{it} \\ & + \mu_6 \text{Investment \%}_{it} + \mu_7 \text{Liquidity index}_{it} + \mu_8 \ln(E_{it}) + \varepsilon_{it} \end{aligned} \quad (3)$$

Second-stage:

$$\begin{aligned} \ln(g_{it}) = & \beta_0 + \beta_1 \ln(\text{Redistrib trans}_{it}) + \beta_2 \ln(\text{Agreem trans}_{it}) + \beta_3 \ln(y_{it}) \\ & + \beta_4 P_{it} + \beta_5 DI_{it} + \beta_6 \text{Investment \%}_{it} \\ & + \beta_7 \text{Liquidity index}_{it} + \beta_8 \ln(E_{it}) + \varepsilon_{it} \end{aligned}$$

For $g_{it-1} > \min \text{ spend}_{it}$

The instrumental variable $\frac{E_{it-1}}{\sum_j E_{it-1}}$ refers to the student enrollment in municipality i , year $t-1$ relative to the sum of student enrollment of all municipalities i in state j ($i \in j$). Our assumption in using this instrument is that after controlling for municipal and time fixed effects, and for our control variables (particularly the political party of the mayor over

time, and the \ln of student population), the variations in the relative student population in the year before are not determined by an effort of the mayor to increase its redistribution transfers in the next year. Our assumption is supported by two main reasons: First, the fact that municipalities do not have control over the efforts of other municipalities in the same state. Second, because a mayor in year t cannot affect its enrollment in the year before (any persistent trend in enrollment over time is already being controlled by $\ln(E_{it})$).

In the median voter model (as discussed in [Appendix A](#)), the elasticity of education expenses to changes in revenue is constant regardless of the type of revenue. It is expected that the public manager rearranges its budget to maintain the same proportion of the budget invested in educational expenses despite the source of revenue. In other words, if the municipal manager is maximizing the preferences of the median voter, as presented in equations (A.1) and (A.2), the elasticity estimated in β_3 of model (2) and the second-stage of model (3) should equal the elasticities estimated in β_1 and β_2 (given the restriction that the municipality is already spending more in education than the mandatory minimum expenditure).

In order to analyze the existence of a flypaper effect, we estimate the increase in education expenses in response to increases in local revenues (represented by β_3) and compare with the increase in education expenses in response to intergovernmental transfers (represented by β_1 and β_2). We interpret the estimated difference as the flypaper effect ($\partial = \beta_{1 \text{ or } 2} - \beta_3$). Next, we estimate the increase in educational expenses in response to different types of intergovernmental transfers (represented by β_1 and β_2). Particularly, we test whether the elasticity of agreement transfers (β_2 in models (2) and (3)) is higher than the elasticity of the redistribution transfers (β_1).

5. Results

5.1. Minimum Spending

What are the effects of a minimum spending rule on educational spending? [Table 1](#) presents the results of the estimation according to model (1). Columns [1] and [2] show the results of those municipalities that are below the minimum in a year, and columns [3] and [4] of those that are above the minimum from one year to another. In addition to controlling for the \ln of the expenses in year $t-2$ and the \ln of revenue in $t-1$, columns [1] and [3] include municipal and time fixed effects, and the expenses of other municipalities weighted by the distance. Columns [2] and [4] show our preferred estimations, including all controls.

The coefficients presented in columns [1] and [2] indicate that the *per capita* difference between spending in $t-1$ and the minimum in t increases spending, when municipalities are below this minimum. Particularly, a 1% increase in the *per capita* difference between spending in year $t-1$ and the minimum in t leads to a 0.033% increase in spending in year t in our preferred estimation. On the other hand, for those municipalities that are above the minimum, the difference decreases spending, as presented in columns [3] and [4]. That is, a 1% increase in the difference decreases spending by 0.010% in year t .

The results presented in [Table 1](#) indicate that the minimum spending rule leads to increases in spending only for municipalities below the minimum. For municipalities above the minimum, the effect is to decrease spending. The results are robust to the inclusion of mayor's party, personnel maximum spending rule, and efficiency indexes.

Our results indicate that municipalities get closer to the minimum spending value every year. Although the total minimum changes over time, we would still expect that municipalities are closer to the minimum rule as every year the municipalities respond to the total minimum value. To check such trend, we need to observe whether the proportion of education spending is getting closer to its minimum value. [Figure 3](#) presents the standard deviation of the municipal proportions and the 25% smaller and 25% larger proportions over time. As

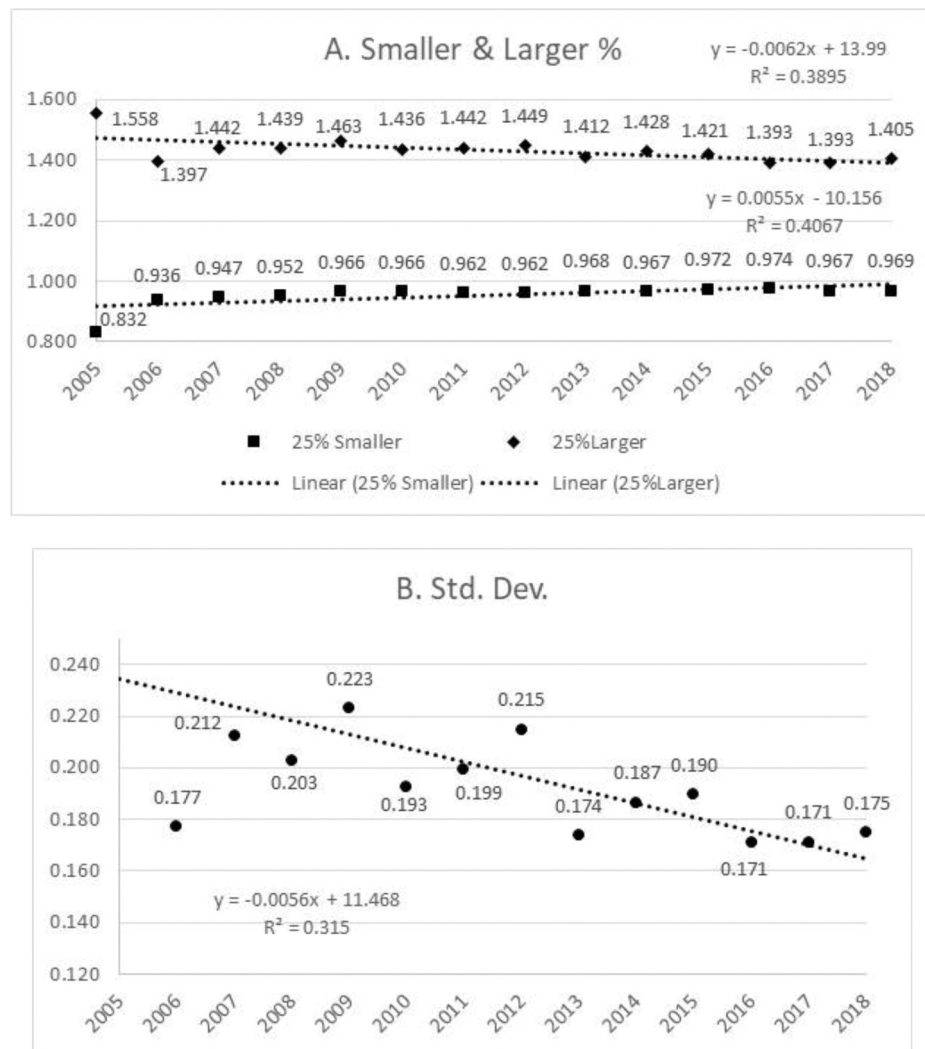
³⁶ We have also restricted our sample to municipalities that were in $t-1$ above the minimum of year t in all years of analysis and found similar results. While we do not present the results of this restricted panel, they are available upon request.

Table 1

Minimum spending.

Sources: SIOPE/FNDE 2005-2018; FIRJAN fiscal management index 2006-2018. Standard errors clustered at the mesoregion level.

	Below the minimum spending		ln(Expenses in educ _{it})		Above the minimum spending
ln(Δ) _{it}	[1]	[2]	[3]	[4]	
	0.041	0.033	-0.016	-0.010	
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	
ln(Expenses in educ _{it-2})	0.022	0.025	0.066	0.065	
	[0.013]	[0.012]**	[0.004]***	[0.004]***	
R ²	0.71	0.75	0.53	0.60	
N	20,930	20,930	45,366	45,366	
Year FE	Yes	Yes	Yes	Yes	
Municipal FE	Yes	Yes	Yes	Yes	
ln(Revenue _{it-1})	Yes	Yes	Yes	Yes	
ln(Exp other munic _{it})	Yes	Yes	Yes	Yes	
Mayor's Party _{it}	No	Yes	No	Yes	
Investment % _{it}	No	Yes	No	Yes	
Liquidity index _{it}	No	Yes	No	Yes	
Personnel % _{it-1}	No	Yes	No	Yes	
D(Personnel Law _{it-1})	No	Yes	No	Yes	
ln(E _{it})	No	Yes	No	Yes	
ln(E _{it-1})	No	Yes	No	Yes	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ **Figure 3.** Education spending as a proportion of total education revenue: 25% Smaller and Larger proportion & Standard deviation of municipal proportions. Sources: FNDE\SIOPE & FGV, 2005-2018.

expected, we observe, in Figure 3.B, a decrease in the standard deviation of the proportion of spending. We also observe, in Figure 3.A, a significant decrease in the 25% larger proportions of spending and an increase in the 25% smaller proportions. Those trends indicate that municipalities get closer to the minimum spending rule (meaning that the proportion of spending to the minimum rule is equal to one) over time.

The positive effect of the difference for those municipalities that are below the rule is expected, as this is a necessary movement to comply with the law. However, it is not clear why the difference to the rule would have any effect on those municipalities that are above the minimum, since they are already compliant with the law. The negative effect of the difference for those municipalities that are above the minimum suggests a behavioral effect of the rule on educational spending. Such behavioral effect may be due, for example, to lower electoral benefits of spending above the minimum.

Budget adjustments could in part be responsible for these effects – particularly due to the changes of FUNDEF-FUNDEB transfers during the year according to the revenue of other municipalities and state. However, if under or overspending of FUNDEF-FUNDEB funds happen,³⁷ the adjustment would not necessarily lead a municipality closer to the overall minimum – only to the FUNDEF-FUNDEB amount. The fact that other adjustments – such as using local revenue to offset a potential overspending of FUNDEB funds, for example – lead municipalities closer to the total minimum spending value (instead of adjusting spending to a level that could be preferable by the median voter) can then be also interpreted as a behavioral effect. While the explanation for this effect is beyond the scope of this paper, it is essential to understand what types of changes in spending occur in response of the minimum rule. Particularly, whether such rule affect the efficiency of education spending.

5.1.a. Minimum Spending and Efficiency

In order to estimate the effect of the minimum spending rule for Brazilian municipalities, we estimate model (1) with the efficiency indexes as our outcome variables, as discussed in the previous section. The results of the estimation for each efficiency index are presented in Table 2. The first row shows the results for those municipalities that were below the minimum, and the second row for those above the minimum in year $t-1$. Each column shows the results of a different efficiency index.

According to Table 2, those municipalities that had to increase education spending to comply with the law had done so by increasing investment and personnel expenditures and improving liquidity. That is, the proportion of investment' and personnel' expenditures are greater in year t for those municipalities that had a greater difference below the minimum in year $t-1$. Municipalities have also increased expenditures by leaving less deferrals from one year to another, improving, therefore, the liquidity index.

This result corresponds to what is found in the literature of the effect of the Fiscal Responsibility Law – which set fiscal and transparency rules to all federative entities, including a maximum proportion of current net revenue that could be spent in personnel (BRASIL 2000). In that context, the Fiscal Responsibility Law increased personnel spending for those below the maximum and decreased for those above. Also similar to this study, investments in infrastructure are the expenses most affected by the Fiscal Responsibility Law – given the other parts of the law related to overall fiscal constraints (Menezes 2006).

³⁷ It is unlikely to happen a significant under or overspending of FUNDEF-FUNDEB funds, since FUNDEF-FUNDEB funds are transferred over the course of the year, and so are the expectations adjusted. For underspending, FUNDEB allows 5% of its funds to be spent in the following year. On the other hand, overspending from one year to another is not possible with FUNDEB funds – it would mean that local funds have to be used to complement the extra spending.

Table 2

Efficiency measures & Minimum spending.

Sources: SIOPE/FNDE 2005-2018, FIRJAN Tax Management Index (IFGF). Standard errors clustered at the mesoregion level.

	Investment % _{it} [1]	Liquidity index _{it} [2]	Personnel % _{it} [3]
<i>Below the minimum spending:</i>			
$\ln(\Delta)_{it}$	0.003 [0.000]***	0.005 [0.002]**	0.001 [0.000]***
R^2	0.12	0.03	0.25
N	20,930	20,930	20,930
<i>Above the minimum spending:</i>			
$\ln(\Delta)_{it}$	-0.001 [0.000]***	-0.011 [0.002]***	-0.000 [0.000]
R^2	0.08	0.03	0.23
N	45,366	45,366	45,366
Year FE	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes
$\ln(\text{Expenses in educ}_{it-2})$	Yes	Yes	Yes
$\ln(\text{Revenue}_{it-1})$	Yes	Yes	Yes
$\ln(\text{Expenses other munic}_{it})$	Yes	Yes	Yes
Mayor's Party _{it}	Yes	Yes	Yes
$D(\text{Personnel Law}_{it-1})$	Yes	Yes	Yes
$\ln(E_{it})$	Yes	Yes	Yes
$\ln(E_{it-1})$	Yes	Yes	Yes

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

On the other hand, for those municipalities that were above the minimum, the difference between how much the municipality is spending in $t-1$ and the minimum in t has decreased the relative spending in investment. It has also decreased liquidity, as estimated by the liquidity index (IFGF, 2017). This decrease in liquidity is probably due to the fact that the municipality responds to the lower minimum spending rule by not spending all the committed spending, decreasing the deferred spending and, therefore, the liquidity. Finally, we find the interesting result that the difference of educational spending in $t-1$ and the minimum rule in t does not affect personnel spending in education. This result contradicts the hypothesis that a minimum spending rule leads to a “cascade effect” on personnel spending – that is, that the increase in personnel spending due to the minimum rule would drive municipalities to an ever-growing spending on personnel due to the rigidity of personnel contracts (Hallerberg, Scartascini, and Stein 2009, chap. 3). We observe, however, that after municipalities have reached the rule, they actually stop increasing personnel spending, while decreasing investment costs.

These results contradict the argument that the minimum spending rule in education is negative to spending efficiency. We observe that the minimum spending rule increases educational expenses of those municipalities below the minimum by increasing not only personnel expenses, but also investment rates. It is not clear, however, if the current minimum rule is an optimal value; therefore, from our results, we cannot affirm if the minimum should increase or decrease. We can, however, assert that an increase in the minimum rule would lead to an increase in educational expenses, and the abolishment of the minimum rule would probably lead local expenditures closer to the median voter preferred values – which are likely lower than the current expenses in education.

5.2. The Flypaper Effect

The results of the estimates regarding the flypaper effect in the use of educational resources of Brazilian municipalities, considering the existence of spending conditionalities, are in Tables 3 and 4. In summary, we find the known flypaper effect for revenues conditioned to education only between redistribution transfers and local resources. The elasticity of education expenses to FNDE intergovernmental transfers is similar to the elasticity to local revenues, and, therefore, is lower than the elasticity of FUNDEF-FUNDEB resources.

Table 3

Elasticities on education expenses.

Source: FNDE/SIOPE 2006-2018. Standard errors are clustered at the meso-region level. N refers to municipalities where *per capita* spending in t-1 (from 2006 to 2017) are greater than minimum *per capita* spending in t (from 2007 to 2018).

	ln(Expenses in educ _{it})		
	[1]	[2]	[3]
ln(Redistrib transf _{it})	0.412 [0.030]***	0.328 [0.022]***	0.337 [0.024]***
ln(Agreem transf _{it})	0.206 [0.024]***	0.056 [0.004]***	0.058 [0.006]***
ln(Local revenue _{it})	0.110 [0.006]***	0.072 [0.006]***	0.072 [0.005]***
R ²	0.61	0.71	0.71
N	50,625	50,625	50,625
Year FE	No	Yes	Yes
Municipal FE	No	Yes	Yes
ln(Expenses other munic _{it})	No	Yes	Yes
Investment % _{it}	No	Yes	Yes
Liquidity index _{it}	No	Yes	Yes
Mayor's Party _{it}	No	Yes	Yes
ln(E _{it})	No	No	Yes
ln(E _{it-1})	No	No	Yes

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4

Elasticities on education expenses, Second stage of IV estimate.

Source: FNDE/SIOPE 2006-2018. Standard errors are clustered at the meso-region level. N refers to municipalities where spending in t-1 (from 2006 to 2017) are greater than minimum spending in t (from 2007 to 2018).

	ln(Expenses in educ _{it})		
	[1]	[2]	[3]
ln(Redistrib transf _{it})	0.306 [0.020]***	0.327 [0.023]***	0.309 [0.015]***
ln(Agreem transf _{it})	0.079 [0.006]***	0.053 [0.006]***	0.053 [0.006]***
ln(Local revenue _{it})	0.076 [0.006]***	0.073 [0.006]***	0.073 [0.006]***
N	50,625	50,625	50,625
Year FE	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes
Investment % _{it}	No	Yes	Yes
Liquidity index _{it}	No	Yes	Yes
ln(Expenses other munic _{it})	No	Yes	Yes
Mayor's Party _{it}	No	Yes	Yes
ln(E _{it})	No	No	Yes

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 3 shows the estimated results of regression (2). Column [1] exhibits the regression estimations without controlling variables. Column [2] presents results controlling for year and municipalities fixed effects, the weighted mean of municipal neighbors' *per capita* expenses in education, mayors' party over time and the management efficiency proxies, and in column [3] municipal enrollment in the same and in the previous year are finally included as controls.

Considering the most restrictive estimation (column [3] of Table 3), a 1% increase in local revenue leads to a 0.072% increase in *per capita* educational expenses. Surprisingly, we find that a 1% increase in agreement transfers is related to a 0.058% increase in educational *per capita* expenses. This greater coefficient associated with local revenues than with agreement transfers suggests the inexistence of a flypaper effect for the agreement transfers. On the other hand, we estimate that a 1% increase in redistribution revenue is related to a 0.337% increase in educational *per capita* expenses, thus, we find a significant flypaper effect in the differences of elasticities for local and state revenues.

Table 4 shows the estimated results of the second-stage of regression (3), using the relative enrollment of the previous year as an instrument

to the redistribution revenue. Column [1] shows the results controlling for municipal and year fixed effects. Column [2] includes the weighted mean of municipal neighbor's *per capita* expenses in education, the mayor's party and the management efficiency proxies, and column [3] controls for the municipal enrollment in year t . All the estimations present a statistically significant coefficient at 1% to the instrument in the first-stage of the IV regression. Specifically, we find the coefficients of 0.018 (SE = 0.001), 0.018 (SE = 0.001) and 0.013 (SE = 0.001) in the three first-stage estimations, respectively.

The results shown in Table 4 are close to those presented in Table 3. As we see in column [3] of Table 4, a 1% increase in local revenue increase is related to a 0.073% increase in the *per capita* educational expenses. The surprising result persists; we find that a 1% increase in agreement revenue is related to a 0.053% increase in educational *per capita* expenses. That means that in the IV estimation the elasticity of expenses to local revenues is also greater than the elasticity of expenses to resources from agreement transfers, although this statistical difference between the coefficients of local revenue and agreement transfers is not observed in column [1] of Table 4. Also agreeing with the interpretations to the naïve results, we estimate that a 1% increase in redistribution transfers is related to a 0.309% increase in educational *per capita* expenses.

Therefore, our results indicate the presence of flypaper effects between local and redistribution transfers – equal to 0.236. However, we do not find any difference in elasticities between local resources and federal transfers from agreements with local governments. These results indicate that mayors respond to increases in agreement transfers similarly as they do to increases in local revenue. This result is particularly interesting given the fact that redistribution transfers refer to state transfers with resources from the redistribution of state and local funds plus federal transfers, while other agreement transfers refer to transfers of only federal funds. It indicates, therefore, that the level of the government responsible for the transfer is less of an issue to the flypaper effect in this context.

If we interpret the results considering the maximization problem presented in equation (A.10) – where $\theta \in (0, 1)$ refers to the illusion level regarding the amount of intergovernmental transfers – the greater elasticity of redistribution transfers suggests that voters are less aware of the FUNDEF-FUNDEB transfers than they are of the FNDE transfers. The particularities of the FNDE and FUNDEF-FUNDEB transfers may justify such results. The “illusion”, or “lack of information” (the value of θ), is probably lower when there is a voluntary agreement for the transfer. Therefore, the fact that part of FNDE transfers occur via voluntary agreements between the municipality and the federal government may lead to lower flypaper effect for these types of transfers.

Another important characteristic of the FNDE transfers to support our findings is the fact that many voluntary agreements determining the FNDE transfers occur directly with the schools, which may also decrease the “illusion” regarding the amount of funds received. Besides, several authors argue that the complexity of the tax structure is an important factor for the fiscal illusion (Turnbull 1998; Oates, 1988; Dollery and Worthington 1996). In this sense, the complexity of the FUNDEF-FUNDEB redistributive structure ratifies the argument that there is greater illusion regarding FUNDEF-FUNDEB's resources.

One could argue that the fact that FUNDEF-FUNDEB funds must be spent only on maintenance and development of education (MDE), and 60% of its total should go to teachers, decreases the degrees of freedom of policy-makers on the possibilities of spending compared to FNDE transfers. However, some FNDE transfers are also earmarked to specific purposes – such as through agreements to receive funds for textbooks or school lunch – while others have restrictions on its use – the “education-salary” transfers cannot be used on teachers' salaries, for example. The greater possibilities of spending of FNDE transfers could, in fact, lead to lower elasticities of expenses, as the funds are more flexible to move within the budget between local and FNDE resources. However, it is unlikely that such increased possibilities of spending explain the

inexistence of flypaper effects of FNDE transfers, compared to FUNDEF-FUNDEB transfers, since FNDE transfers also have different restrictions on spending.

Another important characteristic of the Brazilian intergovernmental transfers is that FNDE values are fixed once the agreement is done, leading to less uncertainty on the amount to be received by local governments compared to FUNDEF-FUNDEB transfers – which depend on other municipalities and the state revenues. On the other hand, FUNDEF-FUNDEB funds are “constitutional” transfers and, therefore, they are less unstable than FNDE funds – meaning that we rarely see delays on FUNDEB transfers, while FNDE resources may not only be delayed, but entire programs can be canceled or transformed by the federal government.³⁸ However, it is important to note that we do not find that political alignment explains the distribution of FNDE transfers to local governments.

6. Conclusion

The effects of earmarking revenues have long been studied in economics (Buchanan 1963). However, the effects of such budgetary choices on spending in specific areas are still unclear (Suzart 2015). This paper analyzes the effects of the Brazilian budget structure on education spending. In Brazil, earmarking for basic education budget is present both for local revenues, with the constitutional minimum spending requirement, and for intergovernmental transfers, with the education redistribution transfers and the education transfers done via one-to-one agreements.

We estimate the effect of the minimum spending rule in Brazil by analyzing the responses of the municipalities to the difference between how much they were spending in one year, and how much they should spend in the next year. We find that such difference led to increases in spending for those municipalities that were below the minimum. Nevertheless, the minimum rule led to decreases in spending for those municipalities above the rule. Moreover, we find that such increases in spending were important not only for increasing personnel expenses, but mostly for investment increases for the municipalities that were below the minimum. For those above the minimum, the difference to the rule has actually decreased spending in investments, while not affecting personnel expenses. These results contradict the hypothesis used for changing the Brazilian Constitution over minimum spending rules, currently under discussion, which claim that such rules decrease the efficiency of educational spending (BRASIL 2019).

Externally collected transfers (as is the case with intergovernmental transfers) only generate increases in expenses when local governments do not offset the amount received via grants by reducing other expenses that use local resources (Gordon 2004). However, an empirical phenomenon called “the flypaper effect” is commonly observed in intergovernmental subsidies and happens when the intended purpose of such transfer is not the “optimal allocation” of funds to the local government. In order to analyze the existence and characteristics of the flypaper effect in a context where both the intergovernmental grants and the local resources have conditionalities to be spent in education,

Appendix A. Flypaper Model

We consider the median voter model as the theoretical reference for the flypaper effect (Cossio (2002) and Turnbull (1998)), and show the characteristics of the Brazilian government spending in education according to this model. Although there is evidence that the median voter model outperforms other models to analyze how demands are aggregated under majority rules to explain general local government expenditures (Bailey and Connolly 1998), there is an extensive literature on the limitations of the median voter model as a benchmark to government decisions.

The suitability of the median voter model as a benchmark to the flypaper analysis depends on the suitability of its hypotheses to the Brazilian municipal context (Bae and Feiock 2004). Our attempt is to consider the particularities of the Brazilian context that conflict with the median voter model to analyze the flypaper effect of intergovernmental transfers. For example, since most Brazilian municipalities are small,³⁹ preferences can

we estimate the elasticity of *per capita* expenses in education to local resources, to the redistribution transfers, and to the intergovernmental transfers via agreements. We restrict our analyses to those municipalities that are not bound by the minimum spending in education, given these conditionalities.

In our preferred model, we use the relative student population in the previous year as an instrumental variable to the redistribution transfers in the year. The results suggest that local resources have a smaller influence on educational expenses than the external transfers represented by the redistribution funds. However, we did not find the existence of flypaper effects from the federal transfers from specific agreements, suggesting that voters have more information about the funds coming from this source compared to the redistribution transfers.

Another important contribution of our article lies in the rich database from 2005 to 2018 used in the estimations, allowing for the inclusion of important covariates in the models. In addition to municipal and time fixed effects, we control our models for the political party of the mayor of the municipality over time – to deal with the mayors’ preference for higher government spending and the potential relationship to its political ability to receive higher intergovernmental transfers. We also control for the variations in educational expenses of other Brazilian municipalities weighted by the distance between the municipalities in question, and for efficiency indexes of government budget decisions.

Our results suggest an important role of redistribution funds in increasing educational expenses in recent years in Brazil. If the goal of the federal government is to encourage municipalities to invest more in basic education, our estimates suggest that redistribution policies are more effective for this purpose than policies of minimum spending from local resources. However, contradicting the current debate over spending rules, the minimum spending policies do not seem to have decreased efficiency of spending in education.

CRedit authorship contribution statement

Tassia Cruz: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. **Talita Silva:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing.

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³⁸ In 2019, for example, several FNDE programs were diminished by the Brazilian Ministry of Education (see Saldaña (2019)).

³⁹ Less than 10,000 inhabitants, according to IBGE (2010).

more likely be multi-peaked (rather than single-peaked), and therefore, the median preference may be even more influenced by special interest groups and political alliances. We include controls in our estimations for political factors and focus our interpretations on the information imperfections for the median voter. Brazil is also an interesting case for analyzing intergovernmental transfers that are part fungible and part non-fungible. Additionally, the different types of intergovernmental transfers to education allow for the estimation of variations in the flypaper effects for different transfer characteristics.

The median voter model

Consider the following maximization problem, as a method of aggregating voter preferences to derive the demand for public spending:

$$\begin{aligned} \text{Max}_{x,g} \quad & U^{MV}(x, g) \\ \text{s.t.} \quad & y^{MV} + t \cdot A \geq x + t \cdot g \end{aligned} \quad (\text{A.1})$$

In the equation above, we have x as quantity of private good, and g as quantity of public provided service consumption, which, in this model, is the same as government spending. y^{MV} is the median voter income, and t is the median voter tax share (assumed to be exogenous). That is, $t \cdot g$ is the payment of each voter to finance the consumption for each additional public spending. A is the intergovernmental transfer and $t \cdot A$ is the share of the intergovernmental transfers received by local governments from higher-level governments. U^{MV} is the median voter utility, which is a non-decreasing function. The public good is produced at unit cost.

The median voter problem refers to the maximization by the public sector bureaucrats of the median voter utility, subject to the restriction that its revenue (income and intergovernmental transfers) must be at least equal to the costs of its public and private consumption. Assuming that U^{MV} is non-decreasing and well-behaved, the budget constraint will hold with equality, so we can substitute x in the maximization problem and we have:

$$\text{Max}_g \quad U^{MV}(y^{MV} + t \cdot A - t \cdot g, g)$$

To solve the problem, we calculate the first order condition by the total derivative in g , as presented below.

$$\begin{aligned} -t \cdot U_x^{MV}(y^{MV} + t \cdot A - t \cdot g, g) + U_g^{MV}(y^{MV} + t \cdot A - t \cdot g, g) &= 0 \\ \Leftrightarrow t \cdot U_x^{MV}(y^{MV} + t \cdot A - t \cdot g, g) &= U_g^{MV}(y^{MV} + t \cdot A - t \cdot g, g) \end{aligned}$$

Using the Implicit Function Theorem, we have:

$$\begin{aligned} \frac{\partial g}{\partial A} &= -\frac{-t^2 U_{xx}^{MV}(\cdot) + t \cdot U_{gx}^{MV}(\cdot)}{t^2 U_{xx}^{MV}(\cdot) - 2 \cdot t \cdot U_{gx}^{MV}(\cdot) + U_{gg}^{MV}(\cdot)} \\ \frac{\partial g}{\partial y^{MV}} &= -\frac{-t U_{xx}^{MV}(\cdot) + U_{gx}^{MV}(\cdot)}{t^2 U_{xx}^{MV}(\cdot) - 2 \cdot t \cdot U_{gx}^{MV}(\cdot) + U_{gg}^{MV}(\cdot)} = \frac{1}{t} \cdot \frac{\partial g}{\partial A} \\ \frac{\partial g}{\partial A} &= t \cdot \frac{\partial g}{\partial y^{MV}} \end{aligned} \quad (\text{A.2})$$

The Flypaper effect

This theoretical result is generally not found in many empirical studies, as showed since early studies as by [Henderson \(1968\)](#), and more recent analysis of education intergovernmental transfers, as by [Gordon \(2004\)](#) and [Ferede and Islam \(2016\)](#), and in the Brazilian context as by [Almeida and Ribeiro \(2016\)](#), [Schettini \(2012\)](#), and [Linhares et al. \(2012\)](#). To understand this anomaly, called the *Flypaper effect*, some economists relax the hypothesis of complete information.⁴⁰ In this paper, we use the model presented in [Turnbull \(1998\)](#).

Turnbull's model of asymmetric information assumes that the goal of the public service supplier is to maximize the level of spending. It also assumes that voters perceive tax bill as a linear function of public goods consumption, as bellow:

$$B = \alpha + \mu \cdot g \quad (\text{A.3})$$

In this model, μ is the voter's perception of the marginal tax price of g , that is, the weighted sum of true marginal tax price (t) and average tax price ($t \cdot \frac{(g-A)}{g}$), in terms of equation: $\mu = (1 - \theta) t + \theta \cdot t \cdot \frac{(g-A)}{g} = t(1 - \frac{\theta A}{g})$, and α is the intercept. Under asymmetric assumption, the voter does not observe the entire amount of aid awarded to the locale. The term θ signals what the voter cannot observe, where $\theta = 0$ means full information, $\theta = 1$ means complete illusion and $\theta \in (0, 1)$ is partial illusion.

[Holsey \(1993\)](#) argues that price illusion is not the only source of fiscal illusion. According to [Holsey \(1993\)](#), imperfect voter knowledge of intergovernmental grants also leads to significant increases in income illusion, as local governments must share the tax payments to pay for such grants. However, the redistributive aspect of the Brazilian intergovernmental grants – particularly the FUNDEF-FUNDEB transfers – indicates that other municipalities are actually paying for the intergovernmental transfers received by a municipality and, therefore, the price of the illusion hypothesis is justifiable in this context.

When $g = 0$, the median voter perception of local taxes is its information of the share received through intergovernmental grants, which is $t(1 - \theta)A$. Therefore, $\alpha = -t(1 - \theta)A$, and the tax bill can be written as: $B = -t(1 - \theta)A + \mu \cdot g$

The costs of its public and private consumption are $x + B = x - t(1 - \theta)A + \mu \cdot g$, and the voter budget constrain can be written as:

$$\begin{aligned} y^{MV} &= x - t(1 - \theta)A + \mu \cdot g \\ \Leftrightarrow x &= y^{MV} + t(1 - \theta)A - \mu \cdot g \end{aligned} \quad (\text{A.4})$$

⁴⁰ Oates (1988) distinguishes the concept of imperfect information from the concept of fiscal illusion. According to [Oates \(1988\)](#), fiscal illusion refers to a systematic misperception of fiscal parameters, where imperfect information is a necessary but not sufficient condition to its existence. Turnbull's model (used in this study) broadens the notion of fiscal illusion to include systematic asymmetric knowledge of tax price.

Then we can substitute x in the maximization problem and we have:

$$\text{Max}_g U^{MV}(y^{MV} + t(1 - \theta)A - \mu.g, g) \quad (\text{A.5})$$

Using the Implicit Function Theorem, we have the following equation, where ∂ is the flypaper effect:

$$\begin{aligned} \frac{\partial g}{\partial A} &> \frac{\partial g}{\partial y^{MV}} \\ \Leftrightarrow \partial &= \frac{\partial g}{\partial t.A} - \frac{\partial g}{\partial y^{MV}} \end{aligned} \quad (\text{A.6})$$

The flypaper effect arises because aid (A) reduces the perceived tax price ($\mu = t(1 - \frac{\partial A}{g})$), leading to a price or substitution effect on the demand for public spending. Therefore, the elasticity of public service consumption to intergovernmental grants is greater than the elasticity of public service consumption to the median voter income, and this difference refers to the flypaper effect. That is, intergovernmental aid (A) is more stimulative than voter income (y^{MV}) on public spending.

Government Spending in Education

As we enter a specific area of the public sector, one needs to be aware of the non-fungibility of intergovernmental transfers and of other conditionalities in local income that are tied to specific areas. As discussed in [Inman \(2008\)](#) and [Vegh and Vuletin \(2015\)](#), a possible explanation for the flypaper effect is the fact that non-fungible conditional fiscal transfers, such as matching grants, are misclassified as unconditional ones.

Going back to the maximization problem under complete information, as presented in [equation \(A.1\)](#): Let us first introduce the Brazilian education funding policies in our equation – the constitutional minimum spending with education (ME) and the intergovernmental transfers to education, particularly, the transfers received through the National Fund for the Development of Education (FNDE) and the FUNDEF-FUNDEB transfers:

Minimum spending with education (ME): $ME = 25\%.y^{MV}$

Intergovernmental transfers to education (IE): $IE = \text{Agreem transf} + \text{Redistrib transf} + A^{ed}$

The government intergovernmental transfers (A) can be written as the sum of intergovernmental transfers to education (IE) and other intergovernmental transfers that are not tied to education (A'):

$$\begin{aligned} A &= \text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A' \\ \Leftrightarrow t.A &= t.(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A') \end{aligned} \quad (\text{A.7})$$

Since government spending in education must be greater than the sum of IE + ME, the budget constraint can be written as:

$$y^{MV} + t.(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A') \geq x + (t.g - 25\%.y^{MV}) + 25\%.y^{MV} \quad (\text{A.8})$$

When $g > \text{Agreem transf} + \text{Redistrib transf} + A^{ed} + 25\%.y^{MV}$

The maximization problem with complete information for the Brazilian median voter focusing on the education sector is:

$$\begin{aligned} \text{Max}_g U^{MV}(y^{MV} + t.(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A') - t.g + 25\%.y^{MV} - 25\%.y^{MV}.g) \\ \frac{\partial g}{\partial (\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A')} = t. \frac{\partial g}{\partial y^{MV}} \end{aligned} \quad (\text{A.9})$$

For $g > \text{Agreem transf} + \text{Redistrib transf} + A^{ed} + 25\%.y^{MV}$

Introducing the asymmetry of information, where $\theta \in (0, 1)$ refers to partial illusion, the maximization problem is:

$$\text{Max}_g U^{MV}(y^{MV} + t(1 - \theta)(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A') - \mu.g, g) \quad (\text{A.10})$$

For $\mu = t.(1 - \frac{\theta(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A')}{g})$

Therefore:

$$\frac{\partial g}{\partial (\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A')} > t. \frac{\partial g}{\partial y^{MV}} \quad (\text{A.11})$$

For $g > \text{Agreem transf} + \text{Redistrib transf} + A^{ed} + 25\%.y^{MV}$

$$\Leftrightarrow \partial = \frac{\partial g}{\partial t.(\text{Agreem transf} + \text{Redistrib transf} + A^{ed} + A')} - \frac{\partial g}{\partial y^{MV}}$$

In this model, we are assuming that funds from intergovernmental transfers tied to education could be used in other government sectors when the intergovernmental transfer does not bind government spending. That is, in this specific case when the municipal government is already spending in education more than the total value tied to education, marginal funds are fungible.

Given this first assumption, we derive from this model that the elasticity of government spending is not affected by the constitutional minimum after the minimum spending is satisfied. That is, when the minimum is a non-binding requirement, increases in local funds are characterized in our model as regular increases in median voter income (y^{MV}), and do not change the elasticity of government spending to y^{MV} .

When we relax the complete information hypothesis, a single term θ indicates that the voter observes different intergovernmental transfers in the same way. However, if the term θ is different for the different types of intergovernmental grants ($\theta^{FNDE} \neq \theta^{FUNDEB} \neq \theta^{A^{ed}} \neq \theta^{A'}$), then the elasticity of government spending to changes in these intergovernmental transfers also vary. Particularly, the higher is the θ^i (where i represents the type of intergovernmental transfer), meaning that the population is less aware of the government transfer; the higher is the increase in government spending (this phenomenon is called as the “overspending hypothesis”, referring to the $\frac{\partial g}{\partial \theta} > 0$). In this sense, we would expect that the higher the level of the transfer source, the higher is θ^i . That is, we would expect that $\theta^{FNDE} > \theta^{FUNDEB}$, since FNDE refers to federal transfers and the FUNDEB includes (in some states) transfers from both the state redistribution and the federal top-off. However, voters may be less aware of certain types of

intergovernmental grants depending on the characteristics of the transfers.

As discussed by several authors, the complex structure of government taxing and spending is associated to several sources of fiscal illusion which are unrelated to the intergovernmental grant system (Oates, 1988; Holsey 1993; Turnbull 1998). The presence of corruption in managing education funds,⁴¹ for example, may lead to greater voter uncertainty, as voters are uncertain about the tax rates that will be imposed to implement public programs, or what they will get for their tax money. The complexity of the Brazilian fiscal structure may also be an important factor in determining uncertainty. As described by Turnbull (1998), uncertainty may additionally reinforce the systematic illusion effects to increase ∂ , although uncertainty alone does not generate flypaper effect. We empirically estimate ∂ – as presented in equation (A.11) – in the context of Brazilian education spending.

Another important point to this analysis is the fact that we are analyzing government spending in education specifically, and not overall government spending. Additionally, one might worry about whether the budget shares spent in education are the most efficient options in allocating municipal funds (Diniz 2012), and the externalities of the subsidized services (Shah 2006), which are beyond the scope of our analysis.

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⁴¹ According to Ferraz et al. (2012), 35% of Brazilian municipalities audited by the Federal Comptroller General (CGU) experienced corruption in the management of education funds.

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