

# Determinants for compliance with budget and deadline in constructions for education purposes: an analysis of cities in Espírito Santo

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This article aims to identify characteristics that contribute to reducing the probability of delays and overpayment related to the construction of schools and other types of Education facilities in municipalities of Espírito Santo. The article carries out a literature review of the topics related to the efficient allocation of public resource and previous studies. The characteristics were then classified in five dimensions. Results indicate that the following variables contribute to avoid or reduce delays: type of bidding process, type of service, number of inhabitants, mayors in their second term and their party. Regarding overpayments, the significant characteristics were type of bidding process, number of inhabitants and the mayor's party. This study contributes to the discussion on how public spending could be more efficient.

**Keywords:** delays and overpayments; public construction; municipalities in Espírito Santo.

## Determinantes para o cumprimento de prazo e preço em obras da educação: uma análise nos municípios capixabas

Objetiva-se com este estudo analisar os determinantes que contribuem para explicar o cumprimento dos prazos e preços em obras do setor de educação nos municípios capixabas. Tem como norteadora a revisão de literatura dos tópicos relativos à eficiência na alocação dos recursos públicos e estudos anteriores. Os determinantes foram classificados em cinco dimensões. Os resultados indicaram que, quanto ao cumprimento de prazo, são determinantes: as modalidades de licitação concorrência pública e convite, o tipo de serviço executado de reforma, o número de habitantes, o governante reeleito e o partido do prefeito igual ao do presidente. Quanto ao cumprimento de preço: a modalidade convite, o número de habitantes e o partido do prefeito igual ao do presidente. Este estudo contribui para a identificação de características que podem auxiliar no aumento da eficiência na alocação dos recursos públicos.

**Palavras-chave:** cumprimento de prazo e preço; obras públicas; municípios capixabas.

## Determinantes del plazo y precio en obras de educación: un análisis en los municipios de Espírito Santo

Este estudio tiene como objetivo analizar los factores determinantes que influyen en el cumplimiento de plazos y precios en las obras en el sector educacional, dentro de los municipios de Espírito Santo. Toma como guía la revisión de literatura de los temas relacionados con la asignación eficiente de los recursos públicos y estudios anteriores. Los factores determinantes se clasificaron en cinco dimensiones. Los resultados indicaron que, para cumplimiento de plazos, son determinantes: procedimientos de licitación de concurso público por invitación, el tipo de servicio realizado como reforma, el número de habitantes, el gobernador reelecto y el partido político del alcalde al ser el mismo del presidente. Los factores que influyen en cuanto al cumplimiento de precios son: los procedimientos de licitación por invitación, el número de habitantes y la adherencia al mismo partido político del alcalde y del presidente. Este estudio contribuye a la identificación de características que pueden ayudar a aumentar la asignación eficiente de los recursos públicos.

**Palabras clave:** cumplimiento de plazo y precio; obras públicas; municipios de Espírito Santo.

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## 1. INTRODUCTION

The present research has the purpose to analyze the determinants that contribute to explain the fulfillment of deadlines and prices in construction works in the education sector, for cities from the state of Espírito Santo.

The debate about the efficient use of public resources has acquired importance regarding good management practices (Diniz, Macedo and Corrar, 2011). This initiative comes from the New Public Management, which consists of the application, in the public sector, of practices from the private sector, seeking to enhance the efficiency of public services to citizens (Hood, 1995).

Efficiently using public resources to ensure the provision of services to the population is a primary function of public administration (Silva Filho et al., 2014). It should be noted that, in the public sector, efficiency is related to the maximization of the utility of goods and services to the population, based on available resources (Matei and Savulescu, 2009).

Construction works are among the goods and services provided to the population, comprising any construction, renovation, manufacture or extension (Brazilian Federal Law no. 8,666/1993, article 6, item I). Because this type of activity usually demands significant amounts of resources, monitoring is key and has been improved through time *via* internet websites that have the objective to increase transparency (Simões and Pereira, 2012).

'Geo-Obras' is one of the portals that allow citizens to monitor online construction works and is used to manage information executed in the state and municipal bodies (TCE-MT, 2015). Geo-Obras consists of a geographic information system that receives data regarding the physical and financial execution of the construction, including even photographs and satellite images (TCE-ES, 2012).

Investments in human capital are key for economic growth and efficient spending in infrastructure. Especially for education, human development is deemed to be key to foster economic and social development (Silva and Almeida, 2012:239). Based on what was previously discussed, this research aims at identifying the determinants that contribute to the efficiency of attending expected deadlines and expenditures in contracts for construction in the Education sector in the state of Espírito Santo.

The following elements were considered as potential determining factors: the type of service, type of construction work, per capita income, level of education in the population, population size, Municipal Human Development Index (HDI), mayor's characteristics and the FIRJAN Fiscal Management Index (IFGF). The methodology consisted in the application of the Tobit model, using the dependent variables to capture the percentages of days in arrears and the amount paid above the budgeted amount.

Regarding the fulfillment of deadlines and original expected expending, empirical evidence indicate the following determinants: the type of bidding, population size, and if the Mayor is from the same party as the President is. In addition, the type of bidding and if the mayor is in his or her second term are also determinants for fulfilling the deadlines.

This study contributes to a better understanding of the determinants of efficient (or not) public expenditures, allowing citizens to put into practice their social control over the efficient allocation

of public resources. The identification of factors that are related to efficiency can contribute to public managers to establish policies to avoid or mitigate delays and to expend more than expected. Thus, it contributes to discussions, at least at the municipal level, on efficiency in the management of public resources.

## 2. LITERATURE REVIEW

### 2.1 PUBLIC RESOURCES EFFICIENT ALLOCATION

The allocative function executed by the State is represented by goods and services provided to the population that contribute to socioeconomic development (Costa et al., 2015). This function results from the need to repair market failures, that make it difficult to maximize resource allocation efficiently (Silva et al., 2010).

Being efficient in allocation is fundamental for public managers to meet the needs of the population because resources are limited. Among the concepts and approaches on efficiency, we present the definition provided by Malena et al. (2013:4):

The concept of efficiency refers to the rational use of the means available to achieve a predetermined goal. Thus, it is the ability to optimally achieve goals using the minimum available time and resources.

Fonseca and Ferreira (2009) argue that efficiency is the ability to use what is available for the purpose of achieving the required result. The concept of efficiency does not only encompasses the allocation of public resources in a way that is more appropriate to the determined objectives, but also leads to the management of processes in order to maintain dynamically adequate relationships (Gomes, 2009). The author further summarizes that “[...] the pursuit of efficiency would consist in maximizing the numerator — the objectives achieved — and minimizing the expenditure of resources through rational processes” (Gomes, 2009: 24).

Regarding the legal aspect, in the Brazilian Federal Constitution of 1988 (article 37), efficiency is conceived as one of the principles of public administration. Regarding the efficiency principle, Meirelles (2006: 94) argues that:

The principle of efficiency requires that the management activity is exercised with promptness, perfection and functional efficiency. It is the most modern principle of the management function [...] demanding positive results for the public and satisfying the needs of the community and its members.

The concept of efficiency considers the means, and not the ends (Castro, 2006). In order to determine the degree of efficiency, it is necessary to define a standard or reference, since it will be possible to carry out confrontations about whether resources are being applied efficiently or not (Diniz,

Macedo and Corrar, 2011). Finally, the principle of efficiency informs the public agent that actions for the society should be carried out promptly and be less costly (Nuintin et al., 2014).

## **2.2 PRIOR RESEARCH AND HYPOTHESES DEVELOPMENT**

Devarajan, Swaroop, and Zou (1996) investigated how public spending can influence per capita income growth. They analyzed 43 developing countries, between 1970 and 1990, concluding that current expenditures are positively related and capital expenditures are negatively related to the per capita income growth rate.

Sousa, Cribari-Neto and Stosic (2005) compared efficiency among municipalities in Brazil, concluding that capitals were more efficient than the rest of the cities. The variables related to greater efficiency are level of urbanization and population size.

Ribeiro (2008) performed a comparison between 17 countries in Latin America, between 1998 and 2002. In the first stage, Costa Rica, Uruguay, and Chile presented the best performance for public service and were relatively more efficient than other countries in the region. In the second stage, the author found that, besides GDP per capita and population size, property rights and public service competence were significantly related to expenditure efficiency. Afonso, Schuknecht and Tanzi (2010) investigated 24 countries that were new members of the European Union and emerging countries from other continents, including Brazil. The variables GDP per capita, property rights, schooling and public servants' competence were positively related to inefficiency.

Godoy (2014) investigated the determinants of efficiency for education and health expenditures. The author identifies several determinants, like population, the percentage of enrollments in public elementary schools, and the level of education of the mayor. The author shows that population and GDP per capita had positive effects on efficiency, and the greater effect on is due to the percentage of enrollment in public elementary schools.

The studies conducted by Devarajan, Swaroop and Zou (1996); Sousa, Cribari-Neto and Stosic (2005); Ribeiro (2008); Afonso, Schuknecht and Tanzi (2010); and Godoy (2014) considered how socioeconomic variables may be related to efficiency. Thus, the first hypothesis in this paper is:

H1: socioeconomic characteristics of the municipalities are determinants of efficiency related to deadlines and/or budgeted expenditures.

Cavalcante (2013) examined the determinants of the performance of Brazilian municipalities, from the point of view of relative government efficiency in the areas of education, health and social assistance. The author's main purpose was to analyze the effects of electoral competition on efficiency from 2002 to 2009. Results suggest that the political dimension is important in explaining the performance of municipal governments, although electoral competition does not influence government efficiency. Both Godoy (2014) and Cavalcante (2013) provide evidence that the manager's political profile is relevant for efficiency. Accordingly, the second hypothesis is presented:

H2: Mayor's characteristics are determinants of efficiency related to deadlines and/or budgeted expenditures.

Tormem, Metzner and Braum (2007) verified which type of bidding brought greater advantages and transparency to the municipality of Capitão Leônidas Marques (State of Paraná), from January to August of 2006. Results indicate that some types of bidding are relevant for bringing positive advantages in terms of pricing and transparency when compared to other types of bidding. Based on these findings, the third and last hypothesis of the study is:

H3: the types of bidding are determinants of efficiency related to deadlines and/or budgeted expenditures.

### 3. RESEARCH METHODOLOGY

#### 3.1 SAMPLE AND DATA SELECTION

The sample was based on the availability of data disclosed at the Geo-Obras internet portal, our primary source of information. Therefore, data was collected from the website <<https://geoobras.tce.es.gov.br>>. The queries were filtered through the options “sector benefited: education”, “status of the construction work: completed and received definitively”. The option of the filter “construction status: completed and definitely received” is aligned with the definitions provided by Brazilian Federal Law no. 8,666/1993, article 73, item I, letter b.

The details of the five dimensions considered in this paper are described below.

— Types of Bidding and characteristics of the construction contract: gathered from the Geo-Obras portal between June 3 and August 12, 2015. The final sample comprises 333 construction works executed and concluded between 2006 and 2015 in 50 municipalities.

The information about socioeconomic characteristics, Mayor’s political profile and the index that measures the quality of municipal tax management were gathered from August 23 to December 16, 2015, as follows:

— Socioeconomic characteristics: collected through the website of the Brazilian Institute of Geography and Statistics (IBGE, in Portuguese), for the 2000 and 2010 censuses. For contracts prior to 2010, we used data from the 2000 census. After 2010, data about the population is available for each year. The Human Development Index (HDI) was collected from the website of the United Nations Development Program (UNDP).

— Political profile of the mayor: *via* electronic access of the Superior Electoral Court (TSE), for the 2004, 2008 and 2012 election years. Data from the 2004 election was used for the years 2006-08; from the 2008 election, for the years 2009-12; and from the 2012 election, for the years 2013-15.

— Municipal tax management index: the Federation of the Industries from the State of Rio de Janeiro (Firjan, in Portuguese), publishes an index that measures the quality of tax management within each city annually, except for the years 2014 and 2015. We used the data up to 2013 for each year and used the information for 2013 as a proxy (same value) for the years 2014 and 2015.

### 3.2 VARIABLES

We first describe the dependent variables, followed by the explanatory variables, divided into: types of bidding, characteristics of the construction works, socioeconomic characteristics, manager's political profile and municipal fiscal management index. Malena and partners (2013) point out that efficiency consists in the ability to reach an already established goal as fast as possible and using the least amount of resources. Therefore, the dependent variables for this study that express the fulfillment of deadlines and prices are  $Efficiency\_deadline_{it}$  and  $Efficiency\_price_{it}$ , where:

—  $Efficiency\_deadline_{it}$ : in order to calculate the efficiency related to deadlines, we first calculate the original deadline ( $Orig\_deadline$ ) based on the number of days. Then we calculate how many days were actually necessary to finalize the construction ( $Act\_deadline$ ). The calculation is based for each construction contract  $i$  signed in year  $t$ . We calculate efficiency based on the percentage difference between the original and the actual number of days necessary to finalize the construction:  $(Act\_deadline - Orig\_deadline)/Orig\_deadline$ .

—  $Efficiency\_price_{it}$ : in order to calculate the efficiency related to the expenditures, we first calculate the original budgeted expenditure ( $Orig\_exp$ ). Then we calculated the total amount of expenditures for finalizing the construction ( $Act\_exp$ ). The calculation is based for each construction contract  $i$  signed in year  $t$ . We calculate efficiency based on the percentage difference between the original and the actual amounts expended to finalize the construction:  $(Act\_exp - Orig\_exp)/Orig\_exp$ .

There are three major types of bidding, based on total amount being contracted by a public entity:

- a) Less than 150 thousand Brazilian reais: this type is typically called "Invitation". At least three companies are invited to send their bids;
- b) Between 150 thousand and 1,5 MM Brazilian reais: first, companies have to be considered able to compete based on specific requirements, such as technical quality. All companies considered that are approved may send their bids. Usually, this type of bidding is called 'Price take' (literal translation from Portuguese).
- c) More than 1,5MM Brazilian reais: any company may send their bids. This type is usually called "Public Competition" and may be used for amounts below 1,5MM as well.

In order to identify the type of bidding, we used two dummy variables:

— Competition: we create an indicator variable that is set to 1 if any competitor may make a bid (i.e., there is public competition); zero, otherwise.

— Invitation: we create an indicator variable that is set to 1 if specific companies are invited to make a bid (i.e., by invitation); zero, otherwise.

There are several different types of services (such as conservation, new construction, maintenance, paving, painting, re-adaptation, reconstruction, renovation, etc.) and different types of constructions (library, roof, day care, school, water treatment plant, wall, public building, sports court, electricity distribution network, administrative unit, and others). To determine the characteristics of the construction works two proxies we used to variables: type of service executed ( $Type\_service_{it}$ ) and the type of construction ( $Type\_construction_{it}$ ).

—  $Type\_service_{it}$ : we create an indicator variable that is set to 1 if the service is related to restoration; zero, otherwise.

—  $Type\_construction_{it}$ : we create an indicator variable that is set to 1 if the construction is related to schools; zero, otherwise.

In relation to the socioeconomic characteristics of the municipalities, four proxies are used: per capita income ( $Per\_capita_{it}$ ), level of education of the population ( $Educ\_level_{it}$ ), population size ( $Size\_pop_{it}$ ) and the Municipal Human Development Index ( $MHDI_{it}$ ), as discussed below.

Devarajan, Swaroop, and Zou (1996) concluded that current expenditures and capital expenditures are related to per capita income growth rates. Therefore, we calculated per capita income as follows:

—  $Per\_capita_{it}$ : per capita income of municipality  $i$  in the year  $t$ .

Afonso, Schuknecht and Tanzi (2010) concluded that the level of education is related to inefficiency. As such, we calculated the level of education as follows:

—  $Educ\_level_{it}$ : logarithm of the average number of school years of the population from municipality  $i$ , represented by the years of study in the year  $t$  (the year that the contract was signed).

Sousa, Cribari-Neto and Stosic (2005) and Ribeiro (2008) concluded that population size is related to efficiency. In our paper:

—  $Size\_pop_{it}$ : was calculated based on the logarithm of the total population of the municipality  $i$  in the year  $t$  (the year that the contract was signed).

Indices such as the  $MHDI_{it}$  correspond to greater efficiency by municipal public management (Leite Filho and Fialho, 2015). The HDI considers three perspectives: longevity, education and income (UNDP, 2016). According to the Human Development Atlas of Brazil (2016), the HDI has a human development classification range: 0 - 0.499 (very low); 0.500 - 0.599 (low); 0.600 - 0.699 (average); 0.700 - 0.799 (high); 0.800 - 1 (very high). Thus, the variable  $MHDI_{it}$ :

—  $MHDI_{it}$ : corresponds to the Municipal Human Development Index of the municipality  $i$  in the year  $t$  (the year that the contract was signed).

In order to represent the manager's political profile, six characteristics were considered: level of education, gender, reelection, if the political party of the mayor is the same as that one from the governor or the president, and its political orientation (left or not). Godoy (2014) found that the level of education of the mayor is related to efficiency. We use an indicator variable ( $Educ\_mayor_{it}$ ) that is set to 1 if the mayor has at least an undergraduate degree; zero, otherwise. We also use an indicator variable for the gender of the mayor ( $Gender_{it}$ ) that is set to 1 if the mayor is a woman; zero, otherwise.

Based on the study by Cavalcante (2013), four characteristics related to reelection and the political party are considered relevant to explain the mayor's performance. Accordingly, we use four proxies:

—  $Reelection_{it}$ : an indicator variable that is set to 1 if the mayor is in his or her second term; zero, otherwise.

—  $Party\_governor_{it}$ : an indicator variable that is set to 1 if the mayor and the State governor are from the same political party; zero, otherwise.

—  $Party\_president_{it}$ : an indicator variable that is set to 1 if the mayor and the President of Brazil are from the same political party; zero, otherwise.

—  $Party\_left_{it}$ : an indicator variable that is set to 1 if the mayor belongs to a left-wing political party; zero, otherwise. Based on Carreirão (2006), the following parties were considered left-wing parties (acronyms in Portuguese): PT, PDT, PPS, PCdoB, PSB, PV, PSTU, PCO and PMN.

In order to consider a proxy for the quality of the fiscal management in each municipality, we applied the Firjan Index of Fiscal Management (FIFM<sub>it</sub>). The FIFM<sub>it</sub> is composed of five indicators: Own Revenue, Personnel Expenses, Investments, Liquidity and Debt Cost, made available by the National Treasury Secretariat (Firjan, 2016). The Index ranges from zero to one and is interpreted by Firjan in the following manner (Firjan, 2016): 0 - 0,4: D (critical); 0.4 - 0.6: C (difficult); 0.6 - 0.8: B (good); 0,8 - 1,0: A (excellence). The FIFM<sub>it</sub> evaluates only fiscal indicators, with emphasis on the Self-Revenue Index, which is aimed at the municipal revenue collection effort (Klering, Krueel and Stranz, 2012). We use the index for each municipality *i* in the year *t* (the year that the contract was signed).

In order to control for the effects of outliers, we used the winsor procedure for the following variables: Efficiency<sub>deadline</sub><sub>it</sub>, Efficiency<sub>price</sub><sub>it</sub>, Per<sub>capita</sub><sub>it</sub>, MHD<sub>I</sub><sub>it</sub>, and FIFM<sub>it</sub>. Table 1 shows the dependent and explanatory variables, as well as the description and the frequency.

**TABLE 1**      **VARIABLES**

VARIABLES	DESCRIPTION	INDICATOR	FREQUENCY
Efficiency <sub>deadline</sub> <sub>it</sub>	(Act <sub>deadline</sub> – Orig <sub>deadline</sub> ) / Orig <sub>deadline</sub>	Continuous	
Efficiency <sub>price</sub> <sub>it</sub>	(Act <sub>exp</sub> – Orig <sub>exp</sub> ) / Orig <sub>exp</sub>	Continuous	
Competition <sub>it</sub>	Public competition <i>versus</i> other types of bidding	1 – public competition 0 - otherwise	35 290
Invitation <sub>it</sub>	Invitation <i>versus</i> other types of bidding	1 – invitation 0 - otherwise	139 186
Type <sub>service</sub> <sub>it</sub>	Restoration <i>versus</i> other types of services	1 - restoration 0 - otherwise	168 157
Type <sub>construction</sub> <sub>it</sub>	Schools <i>versus</i> other types of construction	1 - school 0 - otherwise	178 147
Per <sub>capita</sub> <sub>it</sub>	Per capita income	Continuous	
Educ <sub>level</sub> <sub>it</sub>	Logarithm of the average number of school years of the population	Continuous	
Size <sub>pop</sub> <sub>it</sub>	Logarithm of the total population	Continuous	
MHD <sub>I</sub> <sub>it</sub>	Municipal Humand Development Index	Continuous	
Educ <sub>mayor</sub> <sub>it</sub>	Mayors with at least an undergraduate degree <i>versus</i> mayors without na undergraduate degree	1 – mayors with at least an undergraduate degree 0 - otherwise	173 152

*Continue*



VARIABLES	DESCRIPTION	INDICATOR	FREQUENCY
Gender <sub>it</sub>	Mayor's gender	1 - feminin	26
		2 - masculin	299
Reelection <sub>it</sub>	If the mayor is on his or her second term	1 – mayor in the second term	101
		0 - otherwise	224
Party_governor <sub>it</sub>	If the party of the Mayor and the Governor is the same or not	1 – same party	92
		0 – different party	233
Party_president <sub>it</sub>	If the party of the Mayor and the President is the same or not	1 - same party	10
		0 – different party	315
Party_left <sub>it</sub>	If the Mayor belongs to a left-wing political party	1- left-wing	151
		0 - otherwise	174
FIFM <sub>it</sub>	FIRJAN Index of Fiscal Management	Continuous	

Source: Search data. Elaborated by the authors.

The FIFM was not available for three contracts signed in the municipality of Itapemirim for the years 2013 and 2014. This is why the sample was reduced from 325 to 322 observations.

### 3.3 EMPIRICAL MODELS

We used Tobit regressions because the dependent variables (Efficiency\_deadline<sub>it</sub> and Efficiency\_price<sub>it</sub>) are truncated to zero on the left-side, since there are observations without delays or expending more than originally expected. This technique is used to make inferences without loss of quality (Gujarati, 2006).

In order to examine the relation between the potential determinants with efficiency, we applied the following equation:

$$\text{Efficiency}_{it} = \beta_0 + \beta_1 \text{Competition}_{it} + \beta_2 \text{Invitation}_{it} + \beta_3 \text{Type\_service}_{it} + \beta_4 \text{Type\_construction}_{it} + \beta_5 \text{Per\_capita}_{it} + \beta_6 \text{Educ\_level}_{it} + \beta_7 \text{Size\_pop}_{it} + \beta_8 \text{MHDI}_{it} + \beta_9 \text{Educ\_mayor}_{it} + \beta_{10} \text{Gender}_{it} + \beta_{11} \text{Reelection}_{it} + \beta_{12} \text{Party\_governor}_{it} + \beta_{13} \text{Party\_president}_{it} + \beta_{14} \text{Party\_lef}_{it} + \beta_{15} \text{FIFM}_{it} + \epsilon_{it}$$

Where:

Efficiency<sub>it</sub>: we run different regressions using either Efficiency\_deadline<sub>it</sub> or Efficiency\_price<sub>it</sub> as the dependent variable.

Efficiency\_deadline<sub>it</sub>: (Act\_deadline<sub>it</sub> – Orig\_deadline<sub>it</sub>)/Orig\_deadline<sub>it</sub>, calculated for the construction work *i* in the year *t* (year that the contract is signed).

Efficiency\_price<sub>it</sub>: (Act\_exp<sub>it</sub> – Orig\_exp<sub>it</sub>)/Orig\_exp<sub>it</sub>, calculated for the municipality *i* in the year *t* (year that the contract is signed).

Competition<sub>it</sub>: indicator variable that is set to 1 if the any competitor may make a bid for the construction work *i* in the year *t* (year that the contract is signed); zero, otherwise.

Invitation: indicator variable that is set to 1 if specific companies are invited to make a bid for the construction work  $i$  in the year  $t$  (year that the contract is signed).

Type\_service<sub>it</sub>: indicator variable that is set to 1 if the service related to the construction work  $i$ , signed in year  $t$ , is related to restoration; zero, otherwise.

Type\_construction<sub>it</sub>: indicator variable that is set to 1 if the construction work  $i$ , signed in year  $t$ , is related to schools; zero, otherwise.

Per\_capita<sub>it</sub>: per capita income for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Educ\_level<sub>it</sub>: logarithm of the average number of school years of the population of the municipality  $i$  in the year  $t$  (the year that the contract was signed).

Size\_pop<sub>it</sub>: logarithm of the number of inhabitants from municipality  $i$  in the year  $t$  (the year that the contract was signed).

MHDI<sub>it</sub>: Municipal Human Development Index for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Educ\_mayor<sub>it</sub>: indicator variable that is set to 1 if the Mayor holds an undergraduate degree in the municipality  $i$  in the year  $t$  (the year that the contract was signed).

Gender<sub>it</sub>: indicator variable that is set to 1 if the Mayor's gender is feminine; zero otherwise, for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Reelection<sub>it</sub>: indicator variable that is set to 1 if the Mayor is on his or her second term; zero otherwise, for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Party\_governor<sub>it</sub>: indicator variable that is set to 1 if the party of the Mayor and the Governor is the same; zero otherwise, for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Party\_president<sub>it</sub>: indicator variable that is set to 1 if the party of the Mayor and the President is the same; zero otherwise, for municipality  $i$  in the year  $t$  (the year that the contract was signed).

Party\_left<sub>it</sub>: indicator variable that is set to 1 if the Mayor belongs to a left-wing political party.

FIFM<sub>it</sub>: Firjan Index of Fiscal Management for municipality  $i$  in the year  $t$  (the year that the contract was signed).

We run four different regressions based on the Equation, as follows:

- a) First regression: the dependent variable is Efficiency\_deadline<sub>it</sub>.
- b) Second regression: the dependent variable is Efficiency\_deadline<sub>it</sub>, but restricted to construction works with expected expenditures under 1.5MM Brazilian Reais. We run this specification because it allows to compare if the type of bidding is relevant, since all three types are allowed, according to Brazilian Federal Law no. 8,666/1993.
- c) Third regression: the dependent variable is Efficiency\_price<sub>it</sub>.
- d) Fourth regression: the dependent variable is Efficiency\_price<sub>it</sub>, but restricted to construction works with expected expenditures under 1.5MM Brazilian Reais. We run this specification because it allows to compare if the type of bidding is relevant, since all three types are allowed, according to Brazilian Federal Law no. 8,666/1993.

#### 4. RESULTS

Table 2 presents the results for the two specifications, using  $Efficiency\_deadline_{it}$  as the dependent variable.

**TABLE 2** EFFICIENCY RELATED TO DEADLINES

$Efficiency\_deadline_{it} = \beta_0 + \beta_1 Competition_{it} + \beta_2 Invitation_{it} + \beta_3 Type\_service_{it} + \beta_4 Type\_construction_{it} + \beta_5 Per\_capita_{it} + \beta_6 Educ\_level_{it} + \beta_7 Size\_pop_{it} + \beta_8 MHDl_{it} + \beta_9 Educ\_mayor_{it} + \beta_{10} Gender_{it} + \beta_{11} Reelection_{it} + \beta_{12} Party\_governor_{it} + \beta_{13} Party\_president_{it} + \beta_{14} Party\_left_{it} + \beta_{15} FIFM_{it} + \varepsilon_{it}$				
REGRESSION (1)		REGRESSION (2)		
Number of observations = 322		Number of observations = 309		
Prob > chi <sup>2</sup> = 0.0000		Prob > chi <sup>2</sup> = 0.0000		
Pseudo R <sup>2</sup> = 0.1131		Pseudo R <sup>2</sup> = 0.1231		
VARIABLES	COEFFICIENT $\beta$	PROBABILITY	COEFFICIENT $\beta$	PROBABILITY
Competition <sub>it</sub>	-0.851	0.062*	-1.148	0.048**
Invitation <sub>it</sub>	-1.280	0.000***	-1.305	0.000***
Type_service <sub>it</sub>	-0.533	0.023**	-0.568	0.021**
Type_construction <sub>it</sub>	0.278	0.232	0.229	0.345
Per_capita <sub>it</sub>	0.000	0.728	0.000	0.931
Educ_level <sub>it</sub>	10.775	0.000***	10.835	0.000***
Size_pop <sub>it</sub>	-0.348	0.025**	-0.354	0.037**
MHDl <sub>it</sub>	5.060	0.534	5.882	0.499
Educ_mayor <sub>it</sub>	1.261	0.000***	1.319	0.000***
Gender <sub>it</sub>	0.241	0.611	0.347	0.485
Reelection <sub>it</sub>	-1.015	0.000***	-1.104	0.000***
Party_governor <sub>it</sub>	-0.311	0.438	-0.470	0.264
Party_president <sub>it</sub>	-1.970	0.015**	-11.481	-
Party_left <sub>it</sub>	0.395	0.278	0.535	0.162
FIFM <sub>it</sub>	0.083	0.945	-0.058	0.963

\*\*\*, \*\*, \* indicate that coefficients are statistically significant at the one-, five- and ten-percent levels.

Source: Search data. Elaborated by the authors.

Results indicate that when the type of bidding is by public competition ( $Competition_{it}$ ) or by invitation ( $Invitation_{it}$ ), there is a positive relation with efficiency (negative relation with delays), when compared to the third type of bidding. Our results differ from those presented by Tormem, Metzner and Braum (2007), who concluded that the ‘Price take’ type of bidding was related to better financial advantages. Such divergence may be related to a different object of study, since ours is focused specifically on construction works and theirs, on all types of purchases.

Regarding the characteristics of the constructions works, when the type of service is a restoration ( $Type\_service_{it}$ ), delays are usually lower. Since restorations are commonly used to increase or reduce the spaces, or to maintain the original dimensions (Croce, Mello and Azevedo, 2008), there is a lower level of complexity that contributes to the reduction of delays.

In relation to socioeconomic characteristics, the level of education in the population ( $Educ\_level_{it}$ ) is positively related to delays. This finding is consistent with that presented by Afonso, Schuknecht and Tanzi (2010). On the other hand, population size contributes ( $Size\_pop_{it}$ ) to a reduction in the delays and is in line with results presented by Sousa, Cribari-Neto and Stosic (2005), and Ribeiro (2008), that argue that there is a positive relation between size and efficiency.

Regarding the Mayor’s political profile, results indicate that delays are higher in which the Mayor holds an undergraduate degree ( $Educ\_mayor_{it}$ ). The result found is in line to Godoy’s (2014), in which the level of education of the mayor was pointed to be related to increased efficiency in situations when she or he had only completed elementary education. When other characteristics are considered, delays are negatively related to Mayors in their second term ( $Reelection_{it}$ ) and belonging to the same party of the President ( $Party\_president_{it}$ ). Results are in line with the arguments presented by Cavalcante (2013), that the Mayor’s political profile is relevant for efficiency.

When considering results for regression (2), for just construction works below 1.5MM Brazilian reais, results are similar to those presented in regression (1), except for  $Party\_president_{it}$ , that was not statistically significant.

Table 3 presents the results for the two regressions that use  $Efficiency\_price_{it}$  as the dependent variable.

**TABLE 3** EFFICIENCY RELATED TO EXPENDITURES

$Efficiency\_deadline_{it} = \beta_0 + \beta_1 Competition_{it} + \beta_2 Invitation_{it} + \beta_3 Type\_service_{it} + \beta_4 Type\_construction_{it} + \beta_5 Per\_capita_{it} + \beta_6 Educ\_level_{it} + \beta_7 Size\_pop_{it} + \beta_8 MHDl_{it} + \beta_9 Educ\_mayor_{it} + \beta_{10} Gender_{it} + \beta_{11} Reelection_{it} + \beta_{12} Party\_governor_{it} + \beta_{13} Party\_president_{it} + \beta_{14} Party\_lef_{it} + \beta_{15} FIFM_{it} + \epsilon_{it}$		
	<b>REGRESSION (3)</b>	<b>REGRESSION (4)</b>
	Number of observations = 322	Number of observations = 309
	Prob > chi <sup>2</sup> = 0.0003	Prob > chi <sup>2</sup> = 0.0010
	Pseudo R <sup>2</sup> = 0.1321	Pseudo R <sup>2</sup> = 0.1225

Continue

VARIÁVEIS	COEFICIENTE $\beta$	PROBABILIDADE	COEFICIENTE $\beta$	PROBABILIDADE
Competition <sub>it</sub>	0.0616	0.426	0.070	0.474
Invitation <sub>it</sub>	-0.074	0.098*	-0.078	0.092*
Type_service <sub>it</sub>	-0.014	0.704	-0.014	0.729
Type_construction <sub>it</sub>	0.065	0.094*	0.070	0.086*
Per_capita <sub>it</sub>	-0.000	0.718	-0.000	0.771
Educ_level <sub>it</sub>	0.758	0.064*	0.771	0.077*
Size_pop <sub>it</sub>	-0.050	0.053*	-0.061	0.034**
MHDI <sub>it</sub>	1.009	0.456	1.030	0.476
Educ_mayor <sub>it</sub>	0.158	0.002***	0.161	0.002***
Gender <sub>it</sub>	0.063	0.425	0.071	0.392
Reelection <sub>it</sub>	-0.058	0.181	-0.064	0.167
Party_governor <sub>it</sub>	-0.084	0.228	-0.095	0.204
Party_president <sub>it</sub>	-0.193	0.110	-0.308	0.042**
Party_left <sub>it</sub>	0.115	0.067*	0.121	0.073*
FIFM <sub>it</sub>	0.213	0.282	0.205	0.320

\*\*\*, \*\*, \* indicate that coefficients are statistically significant at the one-, five- and ten-percent levels.

Source: Search data. Elaborated by the authors.

In regression (3), we find a weak relation (significant at the ten-percent level), meaning that the type of bidding ‘Invitation’ (*Invitation<sub>it</sub>*) contributes to the efficiency of expending less for construction works. As with the results for efficiency related to deadlines, this result is different from those presented by Tormem, Metzner and Braum (2007). It is important to highlight, however, that this type is applicable only for amounts below 150 thousand Brazilian reais.

We find a weak result (significant at the ten-percent level) that price efficiency related to building schools (*Type\_construction<sub>it</sub>*) is lower than for other type of construction works. We also find a weak result indicating that the level of education (*Educ\_level<sub>it</sub>*) is negatively related and size (*Size\_pop<sub>it</sub>*) is positively related to efficiency. These results related to socioeconomic characteristics are in line with those presented by Afonso, Schuknecht and Tanzi (2010), Sousa, Cribari-Neto and Stosic (2005) and Ribeiro (2008).

Regarding the Mayor’s profile, we find that their level of education (*Educ\_mayor<sub>it</sub>*) is negatively related to efficiency, in the same line with results for deadlines. We also find a weak relation (significant at the ten-percent level) that Mayors that belong to left-wing parties (*Party\_left<sub>it</sub>*) usually are more

efficient that those from other political orientations. Our results are in line with those presented by Cavalcante (2013) and Godoy (2014).

Results for regression (4) are similar to those presented in regression (3). The only difference is that when considering only construction works below 1.5MM Brazilian reais, there is a weak positive relation with efficiency when the Mayor and the President are from the same party (*Party\_president<sub>it</sub>*).

The following variables are consistently related to efficiency (significant in all regressions): *Invitation<sub>it</sub>*, *Educ\_pop<sub>it</sub>*, *Size\_pop<sub>it</sub>*, and *Educ\_mayor<sub>it</sub>*. In relation to the type of bidding by 'Invitation', our results differ from those presented by Tormem, Metzner and Braum (2007). In relation to the level of education, our results are aligned with those from Afonso, Schuknecht and Tanzi (2010). Also, our results for the size of the population are in line with Sousa, Cribari-Neto and Stosic (2005) and Ribeiro (2008). Finally, the level of education of the Mayor is negatively related to efficiency, partially aligned with Godoy's (2014) results.

Some characteristics show no statistically significant relation with efficiency: *Per\_capita<sub>it</sub>*, *MHDI<sub>it</sub>*, *Gender<sub>it</sub>*, *Party\_governor<sub>it</sub>*, and *FIFM<sub>it</sub>*. Specifically for the per capita income, our results differ from those presented by Devarajan, Swaroop and Zou (1996).

Taken together, our results for the four specifications indicate the following: (H1) there is indication that socioeconomic characteristics (*Educ\_pop<sub>it</sub>* and *Size\_pop<sub>it</sub>*) are related to efficiency; (H2), there is indication that some characteristics of the Mayor (*Educ\_pref<sub>it</sub>*, *Reelection<sub>it</sub>*, *Party\_president<sub>it</sub>*, and *Party\_left<sub>it</sub>*) are related to efficiency; (H3) there is indication that the type of bidding (*Competition<sub>it</sub>* and *Invitation<sub>it</sub>*) is related to efficiency.

Overall, we show that socioeconomic, manager's profile and type of bidding are related to the efficiency of either fulfilling the original expected deadlines and/or the budgeted expenditures for constructions works in the Education sector.

## 5. CONCLUSION

This research had the purpose to analyze the determinants that contribute to explain the fulfillment of the deadlines and prices in construction works in the Education sector. We considered different dimensions related to the type of bidding, socioeconomic characteristics, Mayor's profile, and the characteristics from the contract.

In relation to deadlines, the following characteristics are determinants of efficiency: type of bidding, type of service, population size, type of construction work, reelection and if the Mayor and the President are from the same party. In relation to the budgeted expenditures, the following are determinants of efficiency: type of bidding, population size, and if the Mayor and the President are from the same party.

We specifically draw attention for the results related to the type of bidding. There are several proposals to amend the current text of the Brazilian Federal Law no. 8,666/1993, specially the proposed bill ('Projeto de Lei do Senado') no. 559 (2013). Among the proposed changes, the author suggests that 'Price take' and 'Invitation' should not be allowed. However, based on the results of our research, there is indication that 'Invitation' actually contributes to efficiency.

One relevant limitation is that we considered only construction works in the Education sector and that only those that were finalized were considered. Thus, if new controls were implemented

recently to improve efficiency, it is likely that their effects were not considered in our design because the construction is still undergoing. Future research could expand our results in different sector and government bodies.

Finally, a more in depth analysis is required to better understand why the level of education of the population and of the Mayor are negatively related to efficiency. One possibility is some omitted variable. Thus, we recommend additional research about this topic. Our results may contribute to the implementation of new policies to enhance the use of public resources by identifying some determinants of efficiency.

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