What factors influence the quality of local governments' digital transparency? Evidence from the Brazilian case

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This article investigates the factors associated with the quality of transparency of the websites of Brazilian local governments. We also question the extent to which external control institutions have pressured municipal governments to improve their online transparency. Through multiple regression models, we discuss whether and how socio-demographic, political, and economic variables are relevant to explain the differences in e-transparency in 5,563 cities. The results show that, despite an institutionalization process of public transparency led by federal regulatory evolution, experiences at the local level remain heterogeneous. Population size, GDP per capita, education levels, and voter turnout are statistically important to explain the quality of e-transparency experiences. The main conclusion is that external regulators play a crucial role in shaping digital transparency due to the possibility of imposing legal penalties. Effective use of digital media to foster democratic practices involves pressure from external monitoring agencies willing to challenge a bureaucratic culture resistant to openness.

Keywords: digital democracy; electronic government; transparency; external control; municipal government

Introduction

In recent years, interest in transparency has grown, a phenomenon closely related to the increasing prominence of communication technologies. According to the literature, the efforts of state agents to approve laws facilitating access to information (Michener, 2011, 2015; Cucciniello; Porumbescu; Grimmelikhuijsen, 2017) and the diffusion of digital tools capable of providing information at a low cost (Meijer, 2009) have increased citizens'

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knowledge of government actions (Norris, 2001; Tejedo-Romero; Araujo, 2015; Stohl; Stohl; Leonardi, 2016; Almada, 2017).

However, many investigations and official documents in the fields of digital democracy and public management have pointed out that there are varying levels of sophistication in media platforms that allow monitoring state institutions and political representatives (Lidén, 2015; Lourenço, 2015; Bearfield; Bowman, 2017; Cicatiello; De Simone; Gaeta, 2018). In fact, the degree of refinement may range from precarious websites that do not even meet basic legal requirements to initiatives that go beyond official demands and prioritize optimal administrative practices, promoting democratic innovation[4] (Harrison; Sayogo, 2014). Some of the studies on this topic have identified a set of barriers to successful e-transparency initiatives, such as regional inequalities, demographic and socio-economic differences, variations in political leaders' party membership, and different levels of institutionalization of transparency (Tejedo-Romero; Araujo, 2015; Marques, 2016; Meijer, 'T Hart; Worthy, 2018; Ruijer et al., 2020).

At the same time, although researchers of e-transparency have called for an empirical turn over the last years, a remarkable part of scientific production on this topic has concentrated on governments in Europe and the United States (Alt; Lassen, 2006; Curtin; Meijer, 2006; Bastida; Benito, 2007; Grimmelikhuijsen; Porumbescu; Hong, 2013; Cucciniello et al., 2017). Furthermore, scholarship on digital transparency tends to focus on federal or state government websites (Wong; Welch, 2004; Pérez; Hernández; Bolívar, 2005; Alt; Lassen, 2006; Hong, 2013; Lourenço, 2013, 2015; Almada, 2017; Grimmelikhuijsen; Porumbescu; Kniess; Marques, 2021), with fewer - but growing - studies available at the municipal level (Cruz; Silva; Santos, 2009; Cruz et al., 2012; Araujo; Tejedo-Romero, 2016; Birskyte, 2019; Schmidthuber; Hilgers, 2021). There is, then, a need for more studies on the spheres of local governments to paint a clearer picture of discrepancies in the provision of digital transparency tools and the causes of these inequalities in countries from the Global South.

This article investigates the extent to which socio-demographic, political, and economic factors can explain inequality among Brazilian municipalities concerning e-transparency initiatives (that is, we propose a cross-sectional investigation of which factors are associated with the quality of transparency on the websites of local governments in Brazil). In addition, we question the extent to which external control institutions have pressured the municipalities in question to improve online transparency - a topic the current scholarship has left largely understudied. For example, the Brazilian Public Prosecutor's Office (PPO) has encouraged local governments to improve their digital transparency websites, sometimes imposing legal penalties or proceeding to trial in the

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[4] The Brazil Transparent Scale has shown that the performance of most Brazilian states is higher than 9 (on a scale of 0 to 10) (Controladoria..., 2019a). Regarding the municipalities, the scores are more heterogeneous: while 9% have scores of 9–10, about 21% are graded 0–1; 31% of the cities reach grades from 1 to 3 (Controladoria..., 2019b).

judiciary in cases of wrongdoings (Praça; Taylor, 2014). One of this article's significant contributions is discussing external regulators' roles in shaping digital transparency. We know that there are works on the role of political competition and its influence on government transparency (Berliner, 2014). Still, the literature lacks studies explicitly exploring to what degree external regulators' oversight can drive digital transparency.

Brazil is a country of continental dimensions marked by substantial regional inequalities (Milanovic, 2005) that entail different forms of sociability and political cultures. In light of this, norms of a national scope often end up being selectively adopted, depending on the context and the relations that local political elites establish with other state agents (Praça; Taylor, 2014). For example, control over the abuse of electoral power is more rigid in some regions than others (Fleischer, 1996; Sadek; Cavalcanti, 2003). Thus, developing a study covering data on e-transparency in all 5,563 Brazilian municipalities, emphasizing the pressure that external regulatory institutions exert in the field of politics – contributes to the cutting-edge literature on digital democracy and public administration. Furthermore, different studies indicate that Brazil, due to its economic and territorial dimension, ends up serving as a reference for other Latin American countries (Lau et al., 2008). We reason that studying the country in depth allows us to create a proxy measure to understand better the peculiarities of the Latin American context regarding e-transparency.

Brazil has been a significant player in the field of Internet and Democracy. While some scholars have explored the importance of innovations such as participatory budgeting (Wampler, 2004; Marques, 2010; Touchton; Wampler; Spada, 2019), the country is a founding member of the Open Government Partnership (Open…, n.d.), ranking seventh in the International Budget Partnership (IBP, 2017). Notwithstanding, it is necessary to ask whether and to what extent these policies have been adopted in local municipalities.

Moreover, although there are different indices and evaluation systems for transparency, a cross-sectional measure requires a comprehensive and synchronous diagnosis of Brazilian municipalities – mainly if we consider that Brazil has over five thousand municipalities characterized by a variety of geographical, social, cultural, and economic profiles (Sacramento, 2009; Michener, 2015; Pinho). We throw into question whether a country with different local political cultures, as well as with a particular regulatory and institutional environment (Marques; Miola, 2021), gives rise to different results even if we use some of the variables employed in previous studies aimed to understand successful e-transparency practices.

Lastly, a detailed understanding of local Brazilian initiatives reinforces the intention to de-westernize studies on digital transparency, in addition to enabling a deeper reflection on the political implications of communication technologies on local bureaucratic and administrative structures. Covering e-transparency experiences beyond Europe and North America is still a largely uncharted territory that may add much nuance to the debate (Roett; Crandall, 1999; Moreno, 2002; Haynes, 2013; Hollyer; Rosendorff; Vreeland, 2018).

The article is divided into five parts in addition to this introduction. The following section offers a historical overview of regulatory institutions in Brazil. It also discusses the concept of digital transparency, reviewing previous empirical studies that have examined the more recurrent variables associated with local transparency. Then, we present the methodological strategies applied to analyze the corpus of 5,563 Brazilian municipalities. Afterward, the results are displayed. The final section discusses the findings of our investigation while considering the conclusions of previous studies.

Our regression models indicate a relationship between socio-demographic, political, and economic factors and municipal e-transparency in Brazil, albeit with some singularities worth discussing in detail (that is, despite federal regulations enforcing public transparency, experiences at the local level in Brazil remain significantly heterogeneous). Furthermore, external regulatory agencies have played a critical role in improving Brazilian e-transparency initiatives since they challenge a bureaucratic culture resistant to openness, an issue the literature must address more closely.

Literature review

Control institutions in Brazil: a brief historical overview

The need to improve the control of state agents and institutions has been a burgeoning claim over the last decades. Hannah Pitkin (1967) has already highlighted that representation must go beyond the authorization of the elected, pointing out the importance of monitoring and sanctioning public managers in cases of wrongdoing. In other words, holding clean elections does not suffice to guarantee the endurance of democratic institutions (Azevedo; Anastasia, 2020).

Despite the terminological differences regarding the definition of accountability and transparency, Mainwaring (2003) and Ceneviva (2006) maintain that such principles first became central in Anglo-Saxon countries. In the Brazilian landscape, Campos (1990) contends that the struggle to semantically understand the idea of "accountability" would be a symptom of the absence of this principle in the country's political practices. According to the author, "abuses against citizenship tend to be encouraged [by the public administration], as most of them are rarely revealed, usually go uninvestigated, and [are] never punished. [...] Sharing information with citizens does not constitute the rule in an authoritarian and centralized government supported by technocracy" (p. 8).

Pó and Abrucio (2006) argue that the professionalization of Brazilian bureaucracy gained momentum during the Vargas Era, even though the arrangements adopted at that time were characterized by clientelism and state corporatism. Under the military dictatorship (1964-1985), the technocratic perspective continued as a barrier to transparency. To illustrate this, the 1967 Constitution limited the control or regulation of bureaucracy to its financial and budgetary aspects (Campos, 1990).

It was only following re-democratization and the 1988 Constitution that the debate on control of the bureaucratic apparatus intensified (Medeiros; Crantschaninov; Silva, 2013). From then on, the State reform project carried out throughout the 1990s (Abrucio; Loureiro, 2004) strengthened the legal provisions reinforcing the transparency of public works. The Fiscal Responsibility Law, for example, established a new standard for managing public revenues and expenditures by setting spending limits and punishments for state agents.

Although some new guidelines have been implemented as part of the modernizing process of capitalism in Brazil (Bresser-Pereira, 1997), such transformations have sought to overcome the corrupt and technocratic administration models that characterized the national setting for several decades (Paludo, 2010). The result of this effort is what Filgueiras (2018) calls an "ecology of bureaucracies" of control, which brings together agencies such as the Federal Audit Court, the Public Prosecutor's Office, and the Federal Comptroller's Office, all of which are supported by the Federal Police.

Concerning specifically the Brazilian Federal Public Prosecutor's Office, it is worth mentioning that this is a permanent and autonomous agency (Brazil, 2019, Art. 127). According to Sadek and Cavalcanti (2003), the Constitution assigns two critical functions to the PPO: "to defend the constitutional interests of citizens and society at large and to ensure that the public administration, and all its respective parts, complies with its constitutional responsibilities" (p. 203).

Theory and practice of e-transparency

Commonly understood as "the availability of information about an organization or actor that allows external actors to monitor the internal workings or performance of that organization" (Grimmelikhuijsen; Porumbescu; Hong, 2013, p. 576), the principles of public transparency allow citizens to be aware of decisions affecting their lives. Although discussing transparency is nothing new (Bentham, 1843; Filgueiras, 2011; Angélico, 2016), Fung (2013) considers that four aspects have defined the transparency of public information in recent decades: the availability of information to the public; proportionality of information regarding the importance of institutions and their actions; accessibility of information (so that it can easily be understood and used by people); and capacity for action, facilitating public response to monitor and address demands to government authorities. In other words, in addition to allowing institutions and citizens to track state agents and institutions, public transparency is a prerequisite for accountability (Heald, 2006; Baume; Papadopoulos, 2018).

Nevertheless, transparency scholarship also reflects on the negative consequences of providing information to the public, such as people having less trust in their government (De Fine Licht, 2011; Margetts, 2011; Bauhr; Grimes, 2014; Etzioni, 2018), emergent threats to personal privacy (Schudson, 2020), reduced negotiation capacity in

parliamentary committees (Fasone; Lupo, 2015), and less efficient public management (de Graaf; Paanakker, 2015).

Despite these criticisms, organizations such as Transparency International and the World Economic Forum have striven for governments to implement more sophisticated transparency policies[5]. As a result, in many countries, the trend is a progressive adoption of e-transparency mechanisms, including passing specific legislation (Michener, 2011). In this context, creating regulatory frameworks (such as the Freedom of Information Act) helps predict the quality of information on governments' digital communication platforms (Horsley; Liu; Levenshus, 2010; Berliner, 2014; Michener, 2015; Schnell, 2017).

Cultural and historical issues influence the level of transparency in democratic societies. This means that how transparency is perceived and implemented may vary, as do its political effects (Lyrio; Lunkes; Taliani, 2018; Grimmelikhuijsen; Porumbescu; Hong, 2013). Nevertheless, a key element affecting degrees of transparency is technology: digital communication has played an increasingly important role in facilitating access to government decision-making processes and documents and making access cheaper and more convenient (Piotrowski; Van Ryzin, 2007; Meijer, 2009; Bertot; Jaeger; Grimes, 2010; Margetts, 2011).

The emergence of political, legal, and technological opportunities increases expectations regarding the progressive implementation of transparency initiatives. For example, in Brazil, official monitoring agencies (such as the state and federal Courts of Accounts[6]) as well as institutions including the Federal Senate[7] and civil society organizations such as Contas Abertas (Open Accounting)[8], have proposed different rankings and indices.

Among the measurements applied to assess municipal and state government e-transparency experiences, the one for which the Federal Public Prosecutor's Office (PPO) is responsible deserves to be highlighted. The National Transparency Ranking project, created in 2015, aims to map the transparency of the websites of the 5,568 municipalities and 26 Brazilian states. The agency intends to eventually adopt judicial and extrajudicial measures against mayors and governors who fail to comply with the legislation on transparency (Ministério..., 2019a).

The PPO's evaluation is relevant for two reasons. First, it was carried out at the national level, examining the 5,568 Brazilian municipalities' websites. Second, the ranking and the data it reveals are easily accessible by any citizen (Ministério..., 2019b), who can

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[5] Available at: <http://www3.weforum.org/docs/WEF_White_Paper_Future_of_Government_Council.pdf>. Access on: 21 Jan. 2022.
[6] Available at: <https://portal.tcu.gov.br/fiscalizacao-de-tecnologia-da-informacao/atuacao/avaliacao-de-transparencia>. Access on: 21 Jan. 2022.
[7] Available at: <https://www12.senado.leg.br/transparencia/ctcs/manual-do-indice-de-transparencia-do-legislativo>. Access on: 21 Jan. 2022.
[8] Available at: <https://indicedetransparencia.com/metodologia-2014>. Access on: 21 Jan. 2022.

use the results to aid evaluation activities. We then use the PPO data in the present article as dependent variables for the analysis, as explained in the methods section.

In the next topic, we discuss some previous research findings in e-transparency. We intend to acknowledge the most relevant explanatory variables regarding the quality of local government websites and then provide a solid ground for our hypotheses and research question.

Hypotheses and research question

The field of e-transparency encompasses a body of recent scholarship that directly collaborates to formulate this article's research hypotheses. For example, Araujo and Tejedo-Romero's (2016) work shows that party ideology influenced municipal e-transparency in Spain and that there is a positive relationship between the quality of websites and electoral turnout. The ideology was also a significant element in Guillamón, Bastida, and Benito's (2011) study, which found that municipalities governed by left-wing parties were more transparent than their right-wing counterparts. Sol (2013) reinforces Guillamón et al.'s finding that transparency is linked to the population size of municipalities (capital cities tend to have better results than those in the interior). Similarly, Lowatcharin and Menifield's (2015) results for the American context sustain that the quality of transparency is associated with characteristics such as population size and the average age of residents.

Some Brazilian works have also sought to understand the aspects favoring the quality of municipal e-transparency initiatives. Coelho et al. (2018) confirm the hypothesis that the websites of more populous states tend to perform better in terms of transparency. In a study of the 96 municipalities with the largest number of inhabitants in Brazil, Cruz et al. (2012) observed an association of socio-economic factors with transparency of public management actions. The work of Silva and Bruni (2019) considered a sample of 1,133 municipalities. The authors found that socio-economic variables, such as education and *per capita* income, significantly influenced the success of municipal e-transparency experiences. In this case, the study was based on the Brazil Transparency Scale (EBT) (Controladoria..., 2019b). However, another investigation by Cruz, Silva, and Santos (2009) involving 23 municipalities in the state of Rio de Janeiro did not find a significant relationship between higher transparency levels in local government websites and the variables population and GDP *per capita*.

The methodological strategies employed in most of the studies mentioned above involve the recurrent use of independent variables to expand their explanatory capacity regarding the quality of transparency initiatives. This article, in turn, examines whether and to what extent three factors are associated with the quality of transparency of the websites of 5,563 Brazilian municipalities: (1) socio-demographics, (2) politics, and (3) economics. To the best of our knowledge, no previous study has considered all three factors

at once in attempting to understand how such variables behave in the case of all Brazilian municipalities and interact with external control institutions.

The first factor involves the socio-demographic characteristics of municipalities, such as population size and education level (Cruz et al., 2012; Sol, 2013; Lowatcharin; Menifield, 2015; Araujo; Tejedo-Romero, 2016). Considering the literature mentioned above, we formulate our first research hypothesis:

H1 – Socio-demographic variables are positively associated with the quality of the municipal transparency websites

Regarding the political factors (dimension two), we consider explaining the online municipal transparency levels by highlighting the variable voter turnout rates. Indeed, there is a concern in the literature over identifying the relationship between transparency, political participation, and elections (Benito; Bastida, 2009; Pina; Torres; Royo, 2010; Hollyer; Rosendorff; Vreeland, 2011). According to Sol (2013) and Harrison and Sayogo (2014), higher voter turnout indicates the electorate's greater interest in government activities, which pressures political agents and institutions to be more transparent. Contradicting these findings, Tejedo-Romero and Araujo (2015) and Araujo and Tejedo-Romero (2016) argue that low voter turnout and the electorate's lack of interest in government activities encourage local governments to be more transparent in order to promote political participation.

Nevertheless, the contradictory findings of these studies mean it is essential to test whether there is a significant relationship between voter turnout in the 2014 Brazilian elections and the quality of municipal websites regarding transparency. Thus, our second hypothesis is:

H2 – Voter turnout is positively associated with the quality of transparency on municipal websites

The final explanatory dimension to consider is economics (Alt; Lassen; Shanna, 2006; Piotrowski; Van Ryzin, 2007; Guillamón; Bastida; Benito, 2011; Cruz et al., 2012; Sol, 2013). The *per capita* income variable was one of the first to show a significant positive relationship when gauging the quality of transparency (that is, economically privileged locations have more transparent websites) (Piotrowski; Van Ryzin, 2007; Lowatcharin; Menifield, 2015). Brazilian studies have also indicated, although with a smaller sample size, that the transparency websites of municipalities with a higher Gross Domestic Product (GDP) tend to be more transparent precisely because these locations have more resources (Amorim, 2012; Coelho et al., 2018). Thus, we state our third hypothesis:

H3 – Municipal GDP per capita is positively associated with the quality of transparency of municipal websites

Last, we investigate how the pressure exerted by official external agencies might influence the success of municipal e-transparency initiatives – a critical but rarely discussed topic in the field. Drawing from Simelio et al. (2018), who found that publishing the results of transparency websites evaluations in Catalonia worked as an incentive to improve municipal websites, as well as from the National Transparency Ranking project's data (Ministério…, 2019a), we intend to identify to what extent the improvements in local experiences regarding e-transparency in Brazil are attributable to recommendations from external institutions. As a reference, this research uses data from the two rounds of evaluations conducted by the Public Prosecutor's Office in 2015 and 2016, as we will explain soon. Following the literature, but considering the lack of specific evidence that allows us to have formal hypotheses, we pose the following research question:

RQ – To what extent do the recommendations of the Public Prosecutor's Office contribute to improving Brazilian municipalities' performance regarding e-transparency?

In other words, we propose an explanatory model that considers the performance of municipalities in the 2015 ranking as an independent variable to find out how statistically more robust this model is compared to the others proposed. The following section presents the methodological design, addressing the sample and data collection and analysis strategies.

Methods

The National Transparency Ranking project – one of the primary data sources we use to evaluate the quality of transparency of Brazilian municipal websites – included two series of assessments: the first data collection work took place between 08 September 2015 and 09 October 2015 and resulted in a ranking published by the Public Prosecutor's Office on 09 December 2015. From that date, the Public Prosecutor's Office allowed a deadline of 120 days for the municipalities and states to adapt their websites to comply with Brazilian transparency laws[9]. When this deadline expired, the agency conducted a second round of evaluations, beginning on 11 April 2016 and ending on 27 May 2016. If the recommendations made in the first round were not met, the PPO could take legal action against the agents who did not adapt their websites. The administrative procedures

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[9] Available at: <http://www.leidatransparencia.cnm.org.br/>. Access on: 21 Jan. 2021.

included civil lawsuits and recommending a suspension of the transfer of funds from the federal government to the municipalities (Ministério..., 2019a).

The PPO index varies from zero to ten (0 – 10) and comprises three sets of questions: the first focuses on active transparency and encompasses information on revenue, expenditure, bids, and contracts. The second set emphasizes passive transparency and the Brazilian Freedom of Information Law (LAI) and includes issues such as electronic citizens' information services (Raupp; Pinho, 2016). Finally, the third set of questions addresses good practices, including more prescriptive than normative evaluation elements.

According to the results of the 2015 evaluation, the average grade awarded to the municipal transparency websites was 3.92. In the 2016 assessment, this number rose to 5.21, improving by 32.91%. Figure 1 displays the increase in online transparency scores in all Brazilian states from 2015 to 2016:

Figure 1
Average performance at the national level
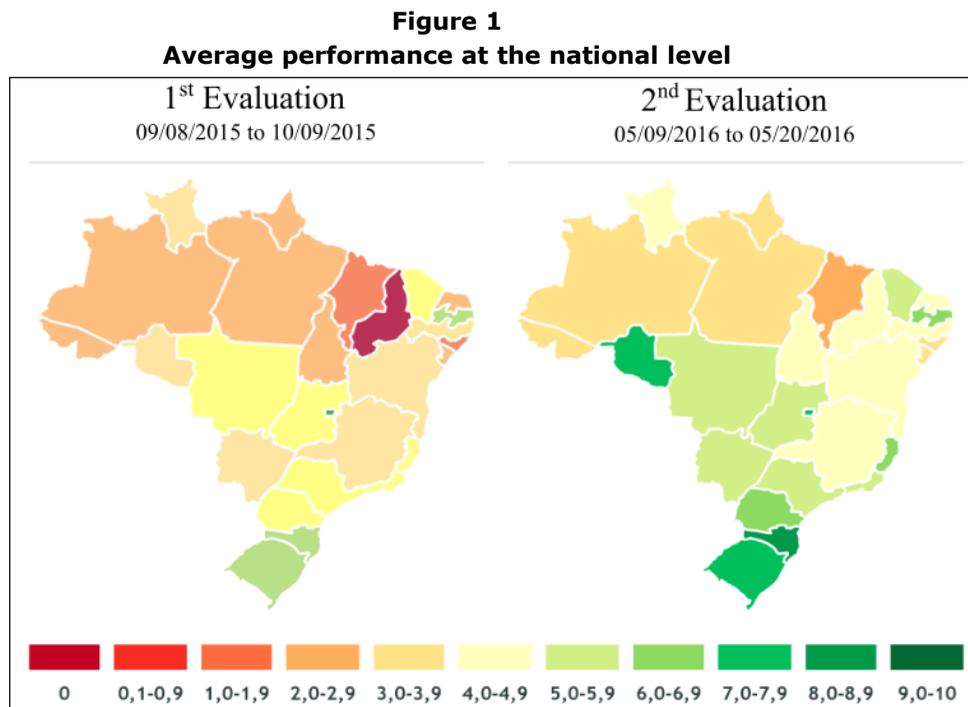
Source: Ministério..., 2019b.

Accordingly, this article's dependent variables are the final scores that the PPO awarded every municipality in the two evaluations they conducted. We test these variables using three different models to explain which factors influence the quality of the transparency of municipal websites.

The dependent variable in the first model is the score awarded in 2015 (*ppi2015*), while the dependent variable in the other two models is the 2016 score (*ppi2016*). Running two tests for the 2016 scores is necessary because the first of these (*ppi2016a*) will draw a direct comparison to the 2015 model. In contrast, the *ppi*2016*b* model will include the 2015 score as an additional explanatory variable. The intention is to gauge whether the evaluation run in 2015 caused any changes in the results as measured in 2016. The paired-sample t-test demonstrated an array of improvements in the e-transparency between the first and the second rounds of evaluation (Mean= -1.297; St. Dev.= 2.482; t= -38.979; p<.001).

As mentioned in the previous section, the independent variables include socio-demographic, political, and economic factors. It should be highlighted that the choice of variables used here is based on examples from previous studies that strove to understand the quality of transparency websites (Inglehart; Welzel, 2005; Alt; Lassen; Shanna, 2006; Piotrowski; Van Ryzin, 2007; Guillamón; Bastida; Benito, 2011; Amorim, 2012; Cruz et al., 2012; Grimmelikhuijsen; Porumbescu; Hong, 2013; Sol, 2013; Lowatcharin; Menifield, 2015; Araujo; Tejedo-Romero, 2016; Coelho et al., 2018). Notwithstanding, more studies need to probe further the relevance of the variables in contexts beyond the United States and Europe.

Concerning the demographic dimension, the municipalities' population size (pop) is one of the variables. We used data from the Brazilian Institute of Geography and Statistics (IBGE, base year 2014) to quantify this variable. It is worth noting that population size was one of the factors already tested in the works of Sol (2013) and Araujo and Tejedo-Romero (2016). The variable used for the social dimension is education, measured using the Municipal Human Development Index (MHDI) developed by the United Nations Development Program (Atlas…, 2013) (base year 2010). Using social variables is also a routine procedure in studies on e-transparency (Cruz et al., 2012; Sol, 2013; Lowatcharin; Menifield, 2015; Araujo; Tejedo-Romero, 2016). Some of these previous studies found that when a population has a higher education level, it influences how people construct socially shared values, strengthening trust and transparency (Inglehart; Welzel, 2005; Grimmelikhuijsen; Porumbescu; Hong, 2013).

An economic variable used recurrently in research on public transparency is Gross Domestic Product or GDP *per capita* (*gdppc*) (Piotrowski; Van Ryzin, 2007; Amorim, 2012; IBGE, 2016; Coelho et al., 2018), the latter being the variable tested here. GDP *per capita* indicates the economic capacity of each municipality, considering its population size. Thus, we intend to measure whether and to what extent the economic factor can stimulate the existence of more efficient websites (Coelho et al., 2018). Once more, the IBGE (base year 2014) provided the database used in this case.

Finally, the variable responsible for guiding the study concerning the political dimension will be voter turnout per municipality in the first round of the 2014 Brazilian elections (the one closest in time to the PPO evaluation) since abstention rates tend to rise

in the runoff (Baquero; Gonzalez, 2011). In this case, we used the data cataloged by the Brazilian Superior Electoral Court (Tribunal…, 2019). The voter turnout (*voterturn*) variable has also been used in previous studies (Sol, 2013; Harrison; Sayogo, 2014; Tejedo-Romero; Araujo, 2015). To characterize the voter turnout variable more accurately, the number of absentee ballots was divided by the number of people eligible to vote.

It is worth adding that the choice of these variables is due to the data's availability and reliability. We gathered data from the highest public statistical authority in Brazil (IBGE) and the Superior Electoral Court, responsible for regulating all electoral processes in the country, as well as information the United Nations produced. Moreover, selecting variables already examined in other contexts allows comparing Brazilian municipalities with other cases studied in the international literature and testing our research hypotheses. Table 1 shows the descriptive statistics.

Table 1
Descriptive statistics

Variables	Mean	St. Dev.	Min.	Max.
Public Prosecutor's Index of 2015 – ppi2015	3.899	2.577	0	10
Public Prosecutor's Index of 2016 – ppi2016	5.196	2.808	0	10
Population (IBGE, 2014) – pop	35,933	210,907	822	11,835,893
Gross Domestic Product per capita (IBGE, 2014) – gdppc (reais, R$)	18,632.25	21,177.02	3,085.49	815,093.79
Education (Atlas…, 2013) – educ	55.90	9.32	20.70	82.50
Voter turnout (Tribunal…, 2019) – voterturn	79,39	6.09	57.81	96.39

Source: The authors, with data from Atlas… (2013), IBGE (2016), Ministério… (2019a), and Tribunal… (2019).

Considering the dependent and independent variables we outline above, the multiple linear regression model is used with the following econometric models:

Model 1. We used regression to gauge which variables have predictive power regarding the PPO transparency scores for 2015.

$$ppi2015 = \beta1 + \beta pop + \beta educ + \beta gdpc + \beta voterturn + \varepsilon \qquad (1)$$

Model 2. Basically, the same regression as in Model 1. In this case, the difference is the dependent variable, which refers to the PPO transparency scores for 2016. This procedure allows us to compare the results of the independent variables for the two models.

$$ppi2016a = \beta1 + \beta pop + \beta educ + \beta gdppc + \beta voterturn + \varepsilon \qquad (2)$$

Model 3. The third model adds the 2015 transparency score to Model 2 as an independent variable. As stated before, we intend to gauge the extent to which the municipalities embraced the PPO recommendations and whether they managed to correct

the problems identified, which can be evidenced by a better performance in terms of the final scores awarded in 2016.

$$ppi2016b = β1 + βpop + βeduc + βgdppc + βvoterturn + βppi2015 + ε \qquad (3)$$

For all the models:

ppi2015 – transparency score for the year 2015, awarded by the PPO;

ppi2016 – transparency score for the year 2016, awarded by the PPO;

β1 – intercept;

β*pop* – population size;

β*educ* – MHDI-education;

β*gdppc* – GDP *per capita*;

β*voterturn* – voter turnout;

β*ppi2015* – transparency score for 2015 from the PPO.

As mentioned above, the PPO indexes considered all 5,568 Brazilian municipalities. However, due to the base year of the HDI being 2010, some municipalities did not yet legally exist at that time (as their emancipation was under legal review). Therefore, we excluded five municipalities from the corpus due to a lack of data on their MHDI. Consequently, this study's final empirical corpus comprises 5,563 municipalities distributed throughout the 26 Brazilian states[10]. As the PPO did not consider the Federal District (DF), it was not included in our study.

Results

We start by presenting the correlations between the dependent and independent variables in Table 2. The data show that all the variables correlate with one another significantly (*p*>.001). This fact is important because it demonstrates that they are somehow either positively or negatively associated. Nevertheless, it should be highlighted that a high correlation among the independent variables (higher than .800) could indicate multicollinearity (Gujarati; Porter, 2011). However, it is possible to verify whether such a problem is found in the models through collinearity statistics. Considering this potential obstacle, we ran the performance of Tolerance and VIF tests. We concluded that they did not indicate collinearity problems for any of the three models this research proposes.

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[10] The excluded municipalities were Paraíso das Águas (MS), Mojuí dos Campos (PA), Pinto Bandeira (RS), Balneário Rincão (SC), and Pescaria Brava (SC).

Table 2
Correlations among the variables

	ppi2015	ppi2016	pop	gdppc	educ
ppi2015					
ppi2016	.578**				
pop	.099**	.090**			
gdppc	.366**	.341**	.117**		
educ	.351**	.318**	.163**	.657**	
voterturn	.258**	.251**	-.110**	.391**	.370**
N	5,563	5,563	5,563	5,563	5,563

Source: The authors, with data from Atlas… (2013), IBGE (2016), Ministério… (2019a), and Tribunal… (2019).

The variables present moderate to low correlation levels, with the highest correlation between the *gdppc* and *educ* variables, with r=.657, and the second highest between the scores for 2015 and 2016, with r=.578. That the correlation does not measure the effect of multicollinearity must be stressed. This means that the degree of correlation could indicate it, but only complementary statistical tests that we will run soon can confirm the effect of multicollinearity.

Having presented the correlations among the variables, we estimated the three models proposed in the methodology section. However, the null hypothesis for homoscedasticity was violated when performing the regression using the ordinary least squares (OLS) method. In other words, the Breusch Pagan test showed p<.05, which indicates heteroscedasticity. Thus, as a corrective measure, the weighted least squares (WLS) method was used, with a standard deviation function, to weigh the observations in our sample (Gujarati and Porter, 2011; Garson, 2013). It is important to say that the variables referring to population size and gdppc were transformed into the logarithmic base.

The first model to be discussed, Model 1a (Table 3), proposes as a dependent variable the transparency scores the PPO issued in 2015, examining them in terms of the previously presented independent variables. As the model used in this case was WLS, it was necessary to adopt a new notation in which the symbol * indicates the weight equation the standard deviation function represented.

Model 1a:
$$ppi15^*=\beta 1^*+\beta pop^*+\beta educ^*+\beta gdppc^*+\beta voterturn^*+\varepsilon^* \qquad (1a)$$

Considering the results presented in Table 3, the proposed model is statistically significant with the value of F(4.5558)=288.893, where *p<.001* and an adjusted R squared of R^2=.172. This means that the independent variables can explain 17.20% of the 2015 PPO evaluation scores. Additionally, all the predictive variables are statistically significant. Of these variables with the higher predictive power, *gdppc* (standardized beta of .199) and *educ* (standardized beta of .166) are the most prominent.

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Table 3
WLS regression coefficients of Model 1a

Model 1a	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-11.410	.603		-18.910	.000		
pop	.320	.063	.064	5.082	.000	.929	1.076
gdppc	1.692	.140	.199	12.070	.000	.548	1.826
educ	4.584	.458	.166	10.013	.000	.545	1.835
voterturn	5.551	.582	.130	9.546	.000	.799	1.252
Dependent Variable: *ppi2015*							
Weighted Least Squares Regression – Weighted by weight							

Source: The authors, with data from Atlas… (2013), IBGE (2016), Ministério… (2019a), and Tribunal… (2019).

Regarding the collinearity of the variables, we found that the tolerance indices vary between 1 and .10, meaning an acceptable level of multicollinearity. Furthermore, the VIF values are lower than 10, indicating no multicollinearity problems (Field, 2009).

In Model 2, the independent variables are the same as in Model 1. The difference is that the dependent variable refers to the websites' performance according to the 2016 PPO evaluation. The method used was Weighted Least Squares.

Model 2a:

$$ppi16^* = \beta 1^* + \beta pop^* + \beta educ^* + \beta gdppc^* + \beta voterturn^* + \varepsilon^* \qquad (2a)$$

Model 2a (Table 3), bringing the scores of the 2016 ranking weighted by the standard deviation, was also statistically significant, with $F_{(4.5558)} = 249.724$, where *p<.001* and an adjusted R squared of $R^2 = .152$. The collinearity statistics presented in Table 4 also indicated the non-existence of multicollinearity problems in this model.

In this Model 2a, which does not present multicollinearity, the variables with the highest predictive power were GDP *per capita* (standardized beta of .184), voter turnout (standardized beta of .144), and education (.142). Comparatively, the R^2 for the 2016 scores was lower than that of the 2015 scores. Thus, the independent variables explain better the 2015 scores than those of the 2016 performance results.

Table 4
WLS regression coefficients of Model 2a

Model 3a	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-10.926	.660		-16.551	.000		
pop	.347	.068	.065	5.092	.000	.923	1.083
gdppc	1.687	.152	.184	11.109	.000	.553	1.808
educ	4.268	.503	.142	8.492	.000	.548	1.824
voterturn	6.684	.642	.144	10.418	.000	.803	1.246
Dependent Variable: *ppi2016*							
Weighted Least Squares Regression – Weighted by weight							

Source: The authors, with data from Atlas… (2013), IBGE (2016), Ministério… (2019a), and Tribunal… (2019).

Finally, only the regression for Model 3 remains. Its purpose is to consider an additional explanatory variable concerning the previous regression: the scores issued to the websites in 2015. As previously mentioned, we expect Model 3 to show higher predictive power and the explanatory variable to be precisely the 2015 score. This expectation is based on the idea that the municipalities will consider the PPO recommendations and adjust their websites after the first round of evaluation.

Model 3, therefore, underwent the same transformations as the previous ones, and the regression method was once again WLS. For each model, there was a different standard deviation function to weigh the variables, with the deviation prepared from the WLS's estimation, as suggested by Garson (2013) and Crowson (n.d.). Thus, the equation for Model 3a is presented as follows:

Model 3a:
$$ppi16^*=\beta1^*+\beta pop^*+ \beta educ^*+\beta gdppc^*+\beta voterturn^*+\beta ppi15^*+\varepsilon^* \qquad (3a)$$

The third proposed model is statistically significant with $F_{(5.5557)}=758.713$, with *p<.001*, and an adjusted R squared of $R^2=.405$. This model does not present multicollinearity problems, and when compared with the previous two, it is the one that with greater explanatory power. In fact, the independent variables have an explanatory power of approximately 40.5% in Model 3a (Table 5):

Table 5
WLS regression coefficients of Model 3a

Model 3a	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-4.990	.554		-9.008	.000		
ppi2015	.574	.012	.536	46.682	.000	.811	1.233
pop	.211	.053	.044	4.016	.000	.885	1.130
gdppc	.726	.127	.082	5.736	.000	.526	1.899
educ	1.279	.417	.044	3.065	.002	.529	1.892
voterturn	4.216	.530	.093	7.956	.000	.776	1.288
Dependent Variable: *ppi2016*							
Weighted Least Squares Regression – Weighted by weight							

Source: The authors, with data from Atlas… (2013), IBGE (2016), Ministério… (2019a), and Tribunal… (2019).

In short, the variables we tested behaved as follows:

Population size. The population size of each municipality was statistically significant in the three models we tested. This means that municipalities with a larger population reached higher scores in the PPO evaluations of their websites regarding transparency.

GDP *per capita*. Municipal GDP *per capita* is one of the most important variables for predicting the performance of local government e-transparency in the first and second models. Even when the dependent variable *ppi2*016 is introduced in the third model, the *gdppc* remains statistically significant. Therefore, municipalities with proportionally higher incomes have more sophisticated e-transparency tools.

Education level. Just as population size and GDP *per capita*, the education levels measured by MHDI-education are positively related to the National Transparency Ranking scores in the three models. More precisely, the data show that more access to formal education is linked to greater local government e-transparency.

Political participation. Voter turnout increases in importance from the first to the second model. In the 2015 evaluation, the standardized beta was .130. In the 2016 assessment, this value rose to .144, lower only than the influence of GDP *per capita*. In the third model, the explanatory power of political participation became the second most important variable, with a beta lower only than the *ppi2*015 variable, introduced as independent in Model 3a. This finding suggests that civic engagement in elections is related to better quality transparency websites.

External monitoring. According to Model 3a, the strength of the independent variable *ppi2*015 is at least five times greater than the explanatory power of the other variables. This means that external assessment contributes decisively to improving municipal e-transparency initiatives.

The results in Table 4 show that the variable with the most significant explanatory power was precisely the one concerning the scores awarded in 2015, with a standardized

beta of .536. Thus, it is worth noting that most Brazilian municipalities upgraded their transparency websites based on the PPO's recommendations. In other words, according to Model 3a, the 2015 scores strongly influenced the improved scores recorded in 2016.

In short, a comparison of the three models based on the adjusted R^2 shows that Model 3a, with $R^2=.405$, has the greatest explanatory power since Model 1a has $R^2=.172$ and Model 2a has only $R^2=.152$.

Discussion

Our research tests three hypotheses. The first one argues that there is a positive correlation between the quality of the municipal transparency websites and socio-demographic variables, such as the size and education level of the population. Actually, the *population* variable was significant in all models tested. This finding corroborates the results of previous studies, according to which population size proved to be an important explanatory factor with regard to improving the quality of transparency of municipal websites (Guillamón; Bastida; Benito, 2011; Sol, 2013; Lowatcharin; Menifield, 2015; Coelho et al., 2018).

The *education* variable, evaluated using the MHDI-education, proved to be positive and significant in the three models at stake, demonstrating that high education levels in municipalities are associated with more high-quality transparency websites. This result means that education may stimulate greater demand for official information and compel public agents to maintain high-quality transparency websites. Thus, the Brazilian case is in keeping with the findings of studies conducted in Spain (Gandía; Archidona, 2008) and other countries (Cicatiello; De Simone; Gaeta, 2018). This confirms hypothesis one.

In line with Sol (2013) and Harrison and Sayogo (2014), the second hypothesis suggested a significant relationship between *voter turnout* and the quality of transparency in municipal websites. This hypothesis was also confirmed since a greater electoral commitment positively affected the scores the PPO awarded to municipal e-transparency initiatives in the three models. However, our findings are contrary to the conclusions of the studies conducted by Tejedo-Romero and Araujo (2015) and Araujo and Tejedo-Romero (2016), according to which low voter turnout led to positive variations in transparency in Spanish municipalities. It is worth noting here that voting is compulsory in Brazil, which could be one reason for this difference. Future analyses might clarify whether municipal government efforts to implement high-quality transparency websites could be associated with the specific intention of reducing the number of absentee voters.

The third hypothesis was that municipal *gdppc* is positively associated with municipal transparency websites with better performance. This hypothesis was also confirmed, as the variable was statistically significant in all three models. Indeed, in the first two models, gdppc is the variable with the most significant influence on the variation of the scores. This finding confirms what scholars already identified in previous analyses

when they found a positive relationship between the sophistication of e-transparency tools and better economic performance (Piotrowski; Van Ryzin, 2007; Lowatcharin; Menifield, 2015; Coelho et al., 2018).

Overall, despite an institutionalization process of public transparency led by federal regulatory evolution, experiences at the local level in Brazil remain significantly heterogeneous (that is, the results unravel that those official initiatives aiming to increase transparency partially depend on factors tied to socio-demographic, political, and economic dimensions). In other words, whether in developed Western countries, such as the United States (Lowatcharin; Menifield, 2015) and Spain (Guillamón; Bastida; Benito, 2011; Araujo; Tejedo-Romero, 2016) – or transitional democracies (Kostadinova; Power, 2007) like Brazil, inner inequalities about population, income, or access to education affect the degree of municipal e-transparency. This finding is relevant since it may help public managers invest public money more effectively and overcome barriers that only cross-sectional and more nuanced investigations can bring.

Finally, it is time to address our research question: To what extent do the recommendations of the Public Prosecutor's Office contribute to improving Brazilian municipalities' performance regarding e-transparency? The outcomes are positive. The results displayed in the National Transparency Ranking improved the performance of the municipal transparency websites, with higher scores in 2016 compared with 2015. The third model, which considered the scores of the 2015 index as an independent variable, showed that this one had the highest predictive power, with an adjusted R^2 of .405. Specifically in Model 3a, using the 2015 scores as an explanatory variable presented a standardized beta of .536, achieving a reliable explanatory power.

Therefore, after receiving the PPO recommendations, the municipalities clearly upgraded their websites, resulting in higher scores in the subsequent evaluation round. In fact, according to a report from the PPO (Ministério..., 2019a), this improvement was seen in 3,751 of the 5,563 municipalities. Accordingly, the 2015 scores could be considered a variable of learning: receiving warnings to identify improvements led the municipalities to correct their e-transparency initiatives. This result corroborates Simelio et al.'s (2018) analysis.

Another opportune reflection involves the argument that digital technologies *per se* do not suffice to spontaneously compel the institutional political culture to adopt higher transparency standards. Only after formal pressure from the Public Prosecutor's Office (and the threat of administrative punishment) did the local managers decide to improve e-transparency tools. In this respect, the effective use of digital media to strengthen democratic practices involves the availability of technical resources and pressure from external monitoring agencies. Therefore, it is worth pointing out that initiatives such as the PPO ranking have contributed to compelling governments and political agents to implement the transparency policies required under Brazilian law.

When external institutions monitor and inspect e-transparency initiatives, there are more significant incentives for institutions to try to improve public services. Thus, from an institutional viewpoint, the importance of two factors must be considered: (1) the existence of a detailed evaluation for each municipality, which helps to inform governments of aspects that they can improve; and (2) negative incentives that compel those in government to comply with the law. Nevertheless, we must criticize the PPO parameters for assessing local initiatives since visibility and transparency do not necessarily have a direct correspondence (Stohl; Stohl; Leonardi, 2016) – that is, the dynamics surrounding the practices in e-transparency are also subject to affordances and visibility management aimed at manufacturing specific ways of accessing public information (Flyverbom, 2016).

Furthermore, the results offer empirical evidence to support Filgueiras' (2018) conclusion that the bureaucracy of control can "challenge the political order and promote institutional changes within the scope of democracy" (p. 358). Nevertheless, despite the progress in the quality of e-transparency tools following the pressure placed on municipal governments by the Public Prosecutor's Office, some inequalities connected to the levels of publicity persist in the Brazilian public administration.

It may be worth stressing that differences in terms of technological structure and human resources cannot be ignored, mainly when the analysis refers to local governments. However, even in the country's most developed regions, some municipalities still do not comply with the legislation. Against this background, we follow Pinho and Sacramento (2009) when they suggest that patrimonialism can adapt to new circumstances. Thus, in addition to strengthening control instruments, it is necessary to transform the mentality of those providing public services. Otherwise, the continuity of a "self-referenced power brings risks to society and democracy" (Pó; Abrucio, 2006, p. 685).

The need to remain attentive to the possible politicization of the control of the bureaucratic apparatus is crucial. Although the 1988 Constitution guarantees autonomy for agencies such as the Public Prosecutor's Office, we must keep in mind that "bureaucracies are not politically neutral... [...] And accountability routines can be a powerful political instrument" (Filgueiras, 2018, p. 372).

Conclusions

This article aims to examine, through multiple regression models and considering data on all the 5,563 municipalities in Brazil, whether and how socio-demographic, political, and economic variables are relevant to explain the discrepancies in municipal e-transparency cases beyond the United States and Europe. Moreover, we questioned the extent to which external control institutions have pressured the municipalities at stake to improve online transparency. Furthermore, we intend to understand the disparities among Brazilian municipalities concerning the promotion of digital transparency, given that the legal directives for transparency at the national level are the same.

We found that the array of institutional transformations characterizing the Brazilian landscape after the 1988 Constitution did not necessarily change the bureaucratic culture that still thrives in some state sectors. Faoro's (1998) classic idea that part of public agents treats the *res publica* as if it were a private asset remains a relevant explanatory key, as suggested by the resistance to social control of a substantial number of municipalities. Although the digitization of public services has experienced relevant improvements, innovations that may jeopardize the power of state agents are viewed with suspicion. Therefore, the work of institutions such as the Public Prosecutor's Office is essential, even if the politicization of such control agencies remains a possibility.

A limitation of the present article is that factors other than those we examine here must be considered when evaluating the degree of sophistication of transparency resources in municipal websites. For example, one holds that aspects such as the mayors' party ideology or the quality of the technological infrastructure that serves the municipality may be related to the success of digital democracy initiatives in Brazil. Additionally, political and technical agents across different countries demonstrate strikingly divergent levels of resistance regarding experiences tied to opening data and e-transparency (Michener; Ritter, 2017). In addition, qualitative interviews may also strengthen the explanation of why external regulators play such an important role and, in particular, why digital transparency tends to be lower in the absence of external oversight. Thus, it is necessary to incorporate the notion that elements of a technological, legal, political, and cultural order interact to play a relevant role in drafting policies to improve public administration transparency.

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Resumo

Que fatores influenciam a qualidade da transparência digital em governos locais? Evidências do caso brasileiro

O artigo investiga que fatores estão associados à qualidade da transparência em sites de governos locais no Brasil. Também questiona em que medida instituições de controle externo têm pressionado os municípios a melhorarem os recursos de transparência online. Por meio de modelos de regressão múltipla, discute de que modo variáveis sociodemográficas, políticas e econômicas são relevantes para explicar as diferenças na transparência digital em 5.563 cidades. Apesar de haver um processo de institucionalização da transparência pública liderado pela evolução da regulamentação federal, os resultados mostram que as experiências em nível local permanecem heterogêneas. Tamanho da população, PIB per capita, nível de educação e a participação eleitoral são estatisticamente importantes para explicar a qualidade das experiências de transparência digital. Conclui-se que agentes reguladores externos desempenham papel crucial na qualidade da transparência digital devido à possibilidade de impor penalidades legais. Uma utilização eficaz dos media digitais para promover práticas democráticas envolve a pressão de agências externas de monitoramento dispostas a desafiar uma cultura burocrática resistente à abertura.

Palavras-chave: democracia digital; governo eletrônico; transparência; controle externo; governo municipal

Resumen

¿Qué factores influyen en la calidad de la transparencia digital en los gobiernos locales? Evidencia del caso brasileño

El artículo investiga los factores asociados con la calidad de la transparencia en los sitios web de los gobiernos locales en Brasil. También cuestionamos hasta qué punto las instituciones de control externo han presionado a los municipios para mejorar la transparencia en línea. A través de modelos de regresión múltiple, discutimos si y de qué manera las variables sociodemográficas, políticas y económicas son relevantes para explicar las diferencias en la transparencia electrónica en 5.563 ciudades. A pesar de un proceso de institucionalización de la transparencia pública liderado por la evolución regulatoria federal, los resultados muestran que las experiencias a nivel local siguen siendo heterogéneas. El tamaño de la población, el PIB per cápita, el nivel de educación y la participación electoral son estadísticamente importantes para explicar la calidad de las experiencias de transparencia electrónica. La principal conclusión es que los reguladores externos juegan un papel crucial en la configuración de la transparencia digital debido a la posibilidad de imponer sanciones legales. Un uso eficaz de los medios digitales para fomentar prácticas democráticas implica entonces la presión de agencias de monitoreo externas dispuestas a desafiar una cultura burocrática resistente a la apertura.

Palabras clave: democracia digital; gobierno electrónico; transparencia; control externo; gobierno municipal

Résumé

Quels facteurs influencent la qualité de la transparence numérique dans les municipalités? Preuve du cas brésilien

L'article étudie les facteurs associés à la qualité de la transparence sur les sites Web des gouvernements locaux au Brésil. Nous nous demandons également dans quelle mesure les institutions de contrôle externes ont fait pression sur les municipalités pour améliorer la transparence en ligne. Grâce à des modèles de régression multiple, nous discutons si et comment les variables sociodémographiques, politiques et économiques sont pertinentes pour expliquer les différences de transparence électronique dans 5 563 villes. Malgré un processus d'institutionnalisation de la transparence publique conduit par l'évolution de la réglementation fédérale, les résultats montrent que les expériences au niveau local restent hétérogènes. La taille de la population, le PIB par habitant, le niveau d'éducation et la participation électorale sont statistiquement importants pour expliquer la qualité des expériences de transparence électronique. La principale conclusion est que les régulateurs externes jouent un rôle crucial dans l'élaboration de la transparence numérique en raison de la possibilité d'imposer des sanctions légales. Une utilisation efficace des médias numériques pour favoriser les pratiques démocratiques implique alors la pression d'agences de contrôle externes prêtes à remettre en question une culture bureaucratique résistante à l'ouverture.

Mots-clés: démocratie numérique; gouvernement électronique; transparence; contrôle externe; gouvernement municipal