



Revista de Administração Pública

ISSN: 0034-7612

ISSN: 1982-3134

Fundação Getúlio Vargas

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Revista de Administração Pública, vol. 52, no. 1, 2018, January-February, pp. 107-125
Fundação Getúlio Vargas

DOI: 10.1590/0034-7612164442

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Beyond contracted prices: determinants of agility in government electronic procurement

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Studies on the effectiveness of government procurement have a prominent focus on contracted prices. However, not much is known about other dimensions of the performance of contracts awarded by the government such as the relation of interdependence between contracted prices and quality. Using delivery time as a dimension for quality, this study explores the mechanisms that influence contracted prices and delivery time. It also discusses how price reduction influences ex-post quality in the context of government electronic procurement. Analysis using a data base with detailed information of 3,755 procurement processes executed by a Brazilian organization of the Federal Public Administration shows that, despite procurement processes being effective to reduce prices in competitive bids, there is no evidence that this price reduction negatively affects delivery time. In addition, results show that suppliers with a history of poor performance are those that keep harming government procurement performance.

Keywords: electronic procurement; bidding; competition; delivery time.

Para além dos preços contratados: fatores determinantes da celeridade nas entregas de compras públicas eletrônicas

Estudos sobre a efetividade das compras públicas frequentemente enfatizam o preço de aquisição. Pouco se sabe, contudo, sobre outras dimensões de desempenho das contratações realizadas pelo governo, incluindo as relações de interdependência entre custo de aquisição e qualidade. Usando a celeridade na entrega como dimensão alternativa de desempenho, este estudo investigou quais são os mecanismos que ajudam a compreender a redução dos preços contratados e dos prazos de entrega dos objetos adquiridos por meio de compras públicas eletrônicas, bem como a influência da economia obtida na fase de licitação sobre a celeridade da entrega. Analisando uma base de dados única, com informações detalhadas de 3.755 processos de compras realizadas por um órgão do governo federal, constatou-se que, embora as licitações eletrônicas sejam eficazes para reduzir preços contratados nos certames de intensa competição, não há relação significativa entre o acirramento da concorrência entre os participantes e a celeridade na entrega. Ademais, os resultados indicam que fornecedores com histórico de desempenho insatisfatório são exatamente aqueles que continuam comprometendo o resultado das compras públicas.

Palavras-chave: licitações eletrônicas; competição; prazo de entrega.

DOI: <http://dx.doi.org/10.1590/0034-7612164442>

Article received on May 25, 2016 and accepted on August 30, 2017.

[Translated version] Note: All quotes in English translated by this article's translator.



Más allá de los precios contratados: factores determinantes para la rapidez en las entregas de compras públicas electrónicas

Estudios sobre la efectividad de las compras públicas frecuentemente enfatizan sobre el precio de adquisición. Sin embargo, se sabe poco sobre otras dimensiones de desempeño de las contrataciones realizadas por los gobiernos. Usando la rapidez en la entrega como una segunda dimensión de desempeño, este estudio investigó cuáles son los mecanismos que ayudan a comprender la reducción de los precios contratados y de los plazos de entrega de los objetos adquiridos en un portal electrónico de compras públicas, así como la influencia del ahorro obtenido en la fase de licitación sobre la rapidez en la entrega. Analizando una base de datos única, con informaciones detalladas de 3.755 procesos de compras realizadas por un órgano del gobierno federal, se comprobó que, aun cuando las licitaciones electrónicas sean eficaces para reducir los precios contratados en concursos de intensa competencia, no existe una relación significativa entre la agresiva competencia entre los participantes y la rapidez en la entrega. Además, los resultados indican que proveedores con histórico de desempeño insatisfactorio son exactamente aquellos que continúan comprometiendo el resultado de las compras públicas.

Palabras clave: licitaciones electrónicas; competencia; plazo de entrega.

1. INTRODUCTION

Public organizations have been increasingly pressured to improve their performance in providing services, amid a context of increasing fiscal constraints (Gill and Frame, 1990; Boyne and Walker, 2010). The need to respond to these pressures has led governmental organizations to take internal measures to improve their performance. These measures affect several areas, including government procurement (Kelman, 2002; Moon, 2002). This means that governmental organizations are increasingly likely to implement tools that can ensure good governance in their contracting processes, for example with online procurement platforms. These tools have been widely used by governments around the globe, mainly because they allow the automation of the bidding process increasing its speed, contributing to reduce contracting costs, and increasing transparency in government expenditure (Moon, 2005; Unpan, 2011).

There is a growing literature focused on the implementation of government electronic procurement platforms (Moon, 2005; Fernandes, 2005; Menezes, Silva and Linhares, 2007; Doherty, McConnell and Ellis-Chadwick, 2013), and their impacts (Croom and Brandon-Jones, 2007; Faria et al., 2010a). However, little is known on the implications of electronic procurement on bidders' behavior and on ex-post indicators of public procurement performance (Freitas and Maldonado, 2013; Reis and Cabral, 2015). In fact, according to Tridapalli, Fernandez and Machado (2011), in spite of the financial potential of electronic procurement, it is necessary to take the discussion to a broader view of supply chain management, considering that it is not rare to see deviations in government electronic procurement, both reported by the Brazilian press and pointed out by the audits of the supervisory agencies. Thus, this study aims to answer the following research question: what are the mechanisms that help to understand the reduction of the contracted prices and of the delivery time of items procured in a government electronic procurement platform?

To answer this question, the study examined a unique dataset with information on 3,755 standardized lots contracted by an organization of the Brazilian federal public administration (FPA) through electronic procurement in the years 2013 and 2014. Using multiple regressions and having

as performance variables the reduction in the contracted price and the agility in delivering the items contracted, the results of the study show that, although the advances provided by electronic procurement have been effective in reducing prices in more competitive processes, it was not possible to identify an association between the reduction in prices bid and the delivery time. However, in line with our theoretical predictions, another factor examined in the study draws attention: suppliers with a track record of poor performance are those that keep harming government procurement performance in terms of price and delivery time. Indeed, reputation — a widely used mechanism to prevent ex post opportunism all over the world (Standifird, 2001; Spagnolo, 2012) — does not appear to be effective in the Brazilian context of government procurement.

In addition to this introduction, the study is organized into seven sections. The second section presents the research's theoretical framework and its hypotheses. The next shows the institutional context of electronic procurement in Brazil. The methodological procedures that guided the research are detailed in the fourth section, and the fifth and sixth sections show the analysis and discussion of the results. The seventh and final section presents the final considerations, limitations and implications of the research.

2. THEORY AND HYPOTHESIS

Considering the impact of information and communication technologies (ICTs) on the operation of organizations, many countries have actively invested in the potential of electronic procurement systems (Unpan, 2011). Among the usual investments, the development of online platforms for electronic procurement stands out. These platforms represent one of the main applications of ICTs in supply chain management in the public sector (Moon, 2002; Tridapalli, Fernandez and Machado, 2011). Electronic procurement is characterized by the accomplishment of all stages of the procurement process in an online environment, enabling online communication and interaction between public agents and private organizations interested in providing goods or services to public administration.

The expected benefits of deploying online procurement platforms have been well documented in the literature and includes financial results such as reduction in contracted prices and transactional costs (Moon, 2002; Unpan, 2011); operational results such as the agility in the adjudication process and the standardization and rationalization of procurement procedures, as well as improving the communication flow between government, supplier and society (Croom and Brandon-Jones, 2007); and strategic results, expanding supply sources and improving transparency, facilitating the monitoring of contracts by public organizations and reducing the potential for corruption (Reis and Cabral, 2015).

However, the use of electronic procurement is recommended only in the purchase of ordinary goods and services, that is, items with low complexity that can be completely specified ex ante (Yukins and Wallace Jr., 2005). It is also recommended in situations where there is a reasonable number of suppliers for the object or service demanded (Caniëls and Van Raaij, 2009). However, even for contracts of low specificity, the use of the electronic platforms raises discussions. Brandon-Jones and Carey (2011) argue that many organizations have not achieved the desired results with the application of electronic contracting systems. One of the main criticisms, particularly in the private sector, is that

the use of e-procurement goes against a consolidated and growing literature in the area of supply chain management that highlights the benefits of developing partnerships and trust between supplier and buyer (Tassabehji et al., 2006), as well as the role of logistic trade-offs in public policies (Vaz and Lotta, 2011).

Likewise, a small but growing number of studies have questioned the impact of electronic procurement on supplier behavior (Caniëls and Van Raaij, 2009; Freitas and Maldonado, 2013). Critics argue that the strong appeal for the value of money and rivalry among bidders in electronic procurement may stimulate opportunistic behavior among suppliers (Jap, 2007). These actors can adopt self-interested strategies regarding delivery time and the quality of the goods and services specified in the public bidding call, as a way to recover the losses incurred during the price dispute (Faria et al., 2010b).

In addition, as electronic procurement is used to reduce barriers to stimulate the participation of suppliers and encourage them to show more aggressive behavior, such events could attract less efficient suppliers, who are more likely to jeopardize the performance of the contract. This is particularly probable in settings where there are insufficient prequalification mechanisms of bidders or inaccurate specifications (Tassabehji et al., 2006). As a result, there is a potential risk that electronic procurement will entail additional ex-post costs that may even exceed ex-ante savings. However, although part of the literature is apprehensive about the consolidation of many of the expected results of electronic procurement, this contracting mechanism is already a consolidated tool and is part of the reality of governments (Unpan, 2011), requiring, of course, adjustments for its proper operation.

The discussion below presents various factors that may influence the performance of electronic procurement, exploring the role of the competitive environment (Bulow and Klemperer, 1996), the role of cumulative competencies (Teece, Pisano and Shuen, 1997) and the role of reputation on contracting performance (Spagnolo, 2012).

2.1 COMPETITIVE ENVIRONMENT

Procurement theories posit that favorable conditions for entry of new participants in a bidding process increase competition, resulting in contracted prices reduction (Bulow and Klemperer, 1996). In this sense, considering assets of relatively low specificity and the ability of government electronic procurement platforms to reduce barriers to enter and simplify the procurement process — allowing the reduction of participation costs for geographically dispersed suppliers, — it is possible to say that online procurement contributes to an increase in the number of suppliers competing for the contract. A greater number of participants can be translated into gains for the buyer in terms of contracted prices. Therefore, a positive association between the number of bidders and the savings obtained in electronic procurement is expected. Thus:

H1: The greater the number of competitors in government electronic procurement, the greater the savings in contracted prices.

Although the literature emphasizes the importance of the variable ‘price’ as a measure of government procurement performance, it is a consensus that the economy obtained in the procurement process becomes relevant only when it is qualified by other dimensions of performance that include,

for example, the timing and quality of the product/service delivery (Ba and Pavlou, 2002; Vaz and Lotta, 2011). This means that a satisfactory performance of an acquisition goes far beyond the price reduction, and it is also necessary to avoid ex post adjustment costs, ensuring that goods/services are delivered on time and with the specifications set out in the public bidding notice, in order to accomplish the users' expectations regarding the object of the acquisition.

Therefore, a potential problem of electronic procurement stems precisely when the 'success' of this contracting mechanism reveals bids that are potentially impracticable. This is because the emphasis on price reduction during the procurement process can produce an adverse selection, inhibiting the participation of more qualified suppliers who want to compete in quality and delivery time (instead of price) (Caniëls and Van Raaij, 2009), especially in procurement with mechanisms of prequalification of suppliers and with insufficient specifications (Tassabehji et al., 2006). In addition, suppliers may also feel the need to reduce the quality of the goods and services offered in order to support the decline in their margins and become more competitive in the low price dispute (Jap, 2002).

In the Brazilian context, previous studies, such as those carried out by Freitas and Maldonado (2013), warn that it is usual for a company to be awarded a contract in an electronic procurement process for a price that is much lower than the prices practiced in the market, and that this company is not able to deliver according to its own bid. This process of underestimation could be explained both by the inexperience of the buyer organization who is led by the climate generated with the intensification of the competition and by the deliberate action of the supplier to avoid losing the contract. In the latter case, suppliers could reduce their prices based on the expectation of an ex post adjustment or simply the delivery of a lower quality product or service, with specifications that do not comply with the rules stated in the public bidding notice. Thus, given that opportunistic behavior seems to be feasible in government electronic procurement, it is possible that the economy obtained in the procurement process may be transitory (Tassabehji et al., 2006), in a clear expression of logistical trade-offs between cost, quality, delivery time and positive or negative externalities (Hart, Shleifer and Vishny, 1997; Vaz and Lotta, 2011). Therefore:

H2: The greater the savings obtained in the electronic procurement, the longer the delivery time of the contracted good.

2.2 ACCUMULATED CAPABILITIES

Organizational capability or competence is a concept widely used in the strategic management literature (Teece, Pisano and Shuen, 1997), and recently employed in the Public Administration realm (Piening, 2013; Cabral, 2017). The concept points to the importance of combining a set of tangible and intangible resources that allow organizations to compete in the marketplace in order to achieve superior performance (Barney, 1991). For Winter (2003), organizational capability essentially refers to the set of internal processes, routines and skills that an organization develops to efficiently manage its finalistic activity and differentiate itself from its competitors.

Regarding the development of organizational capabilities, it is important to highlight the difficulty in establishing what are the actions that an organization must adopt to build performance-driven capabilities. However, Teece, Pisano and Shuen (1997) recognize that the knowledge and experience accumulated by organizations are important means for the development of capabilities and competences.

According to Barney (1999), in order to develop a particular capability the organization must undergo, in some cases, an intense and long process of learning, since the experiences accumulated throughout its history will enable the learning of new practices and routines that can establish organizational capabilities. Therefore, learning is a process that combines experimentation and repetition for the purpose of improving, continuously, organizational performance (Eisenhardt and Martin, 2000).

Hence, it is expected that the learning obtained by organizations over time will enable value creation in government electronic procurement (Cabral, 2017). As a result, it is possible to say that more experienced suppliers have accumulated potentially more valuable capabilities and, therefore, are able to offer a product or service that meets the specifications set forth in the public bidding call. These include lower prices than those offered by less experienced competitors, or superior quality, at the same price as competitors. Therefore:

H3: The greater the accumulated capabilities by the winning bidder, the greater the savings in contracted prices.

H4: The greater the accumulated capabilities by the winning bidder, the shorter the delivery lead-times.

2.3 REPUTATION

While it is recognized that increased competition may stimulate opportunistic behavior in contractual relationships, several studies have demonstrated that such behavior can be avoided by using contractual terms that reinforce the desire to build a reputation or the intention of rewarding a previous attitude (Barney and Hansen, 1994). Even when contracting low complexity products, where quality and delivery time can be easily specified, researchers and industry experts recognize reputation as a crucial element in reducing transaction costs and increasing efficiency in relationships customer-supplier, especially in a context of repeated interactions and information asymmetry (Spagnolo, 2012).

A supplier's reputation represents the current assessment of their ability to perform the contract with a satisfactory result. Such assessment is based on supplier's past performance with the contracting organization or based on information from third parties. For Barney and Hansen (1994), the importance of building a positive reputation arises, in part, from the supplier's inability to manipulate their own reputation. Thus, the risk of losses resulting from a reputation damaged by opportunistic conduct in past transactions, together with the supplier's inability to manipulate their own reputation, creates favorable conditions for a reputed supplier to continue to act responsibly and reliably in current and future transactions, because their behavior will have consequences for their reputation (Standifird, 2001; Ba and Pavlou, 2002). From this perspective, it is noted that reputation-based incentive mechanisms have been widely used in private online shopping platforms, such as in the cases of feedback from users of Amazon, eBay and Freelancer.com.

In the public sector — although recent literature underscores the importance of performance history as a measure of reputation for government procurement, as several similar contracts are carried out throughout the year (Spagnolo, 2012) — it is rare to observe cases in which reputation mechanisms are employed in order to improve electronic procurement. In addition, it is worth observing that in the absence of mechanisms that allow punishing suppliers with records of poor performance or rewarding suppliers with good performance, the construction and maintenance of a reliable reputation does not seem feasible. Thus, considering that the Brazilian procurement regulation does not allow the use

of this type of mechanism in electronic procurement, it can be assumed that suppliers with records of poor performance will be those that will present problems in the execution of the contract. Thus:

H5: The greater the records of poor performance of a supplier, the longer the delivery lead- times for a given product.

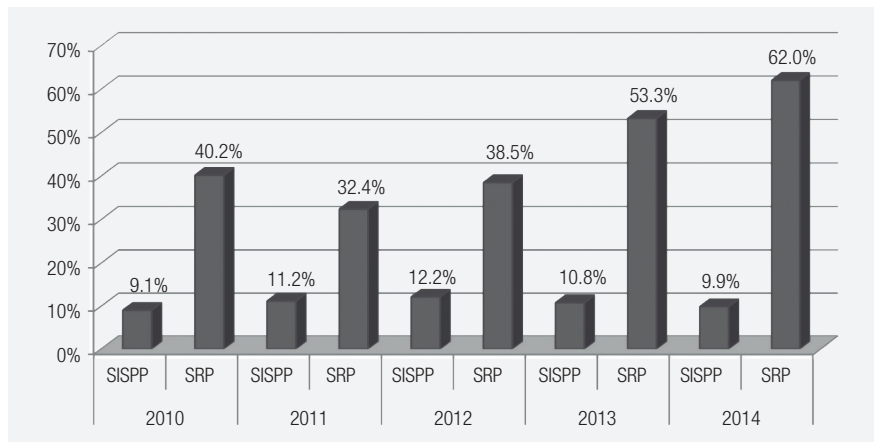
3. GOVERNMENT ELECTRONIC PROCUREMENT IN BRAZIL

In Brazil, government electronic procurement was established in the early 2000s through reverse auctions, which is exclusively intended for the procurement of ordinary goods and services in the market, regardless of the amount to be purchased, adopting the criterion of “lowest price” to select the supplier. The entire electronic procurement process is via the internet, and the bidding contest is conducted in a virtual room of a system owned by the public authority. The Brazilian Federal Government e-Procurement system (Comprasnet) is the main platform used to operate government electronic procurement processes and to make available information on public bidding, the minutes of the bids and the contracts awarded by the federal government agencies. Every day, about 400 procurement processes are conducted on Comprasnet (Brasil, 2015).

By establishing the reverse auction in the electronic format, the government sought to increase competitiveness and agility in public contracting, taking advantage of the internet. Among the innovations introduced by electronic procurement, it is worth mentioning the permission for its use in contracting procedures through the price registration system (SRP). The main characteristic of this system is the fact that it is not mandatory for the government to buy the object or service procured. In the modalities that do not use the SRP, the procurement is intended to select the supplier and the bid for a specific contract (SISPP) which is then awarded by the public administration to the supplier at the end of the process. In the SRP, the purpose of the procurement is to select the supplier bidding at the lowest price, for future contracts. Thus, after the procurement process, prices and conditions of acquisition are recorded in the minutes of the registration of prices, for a period of up to 12 months, and it is the responsibility of the public administration to use these minutes when deemed necessary.

Regarding the applicability, the SRP should be adopted preferably: i) when, because of the characteristics of the object or service, there is need for frequent contracting; ii) when it is not possible to predefine the quantity required; iii) when it is more convenient to purchase goods to be delivered intermittently. Last, iv) when it is more advantageous the acquisition of goods or the contracting of services to serve more than one agency or government program. Assuming that most of the activities carried out by public agencies involve frequent contracting of goods and services to be delivered or rendered from time to time, there has been an increase in the use of electronic procurement using the price registration system in the last five years (figure 1). In this period, 98.8% of the federal government's procurement process were electronic, and the SRP accounted for 40.2% of the total amount of bids in 2010. In that year, the reverse auction for specific contract (SISPP) represented only 9.1% of the total bid amount. Despite a fall in 2011, the SRP share in the amounts procured showed a growth trend between 2011 and 2014, while the amounts procured through the SISPP maintained a quite constant percentage throughout the analyzed period (10.6%). In 2014, the SRP totaled 60.2% of the amount procured by the federal government.

FIGURE 1 PERCENTAGE OF THE AMOUNT PROCURED IN REVERSE AUCTION FOR SPECIFIC CONTRACT (SISPP) AND SRP, FROM THE TOTAL AMOUNT PROCURED BY THE FEDERAL PUBLIC ADMINISTRATION



Source: Brasil (2015).

4. METHODOLOGY

The data used in the research include information on 3,755 standardized lots that were procured through reverse auction in the electronic format, using the price registration system (SRP), by an organization of the Federal Public Administration (FPA) linked to the Ministry of Education (Organization X), in the years 2013 and 2014. The unit of analysis used is the standardized lots, which are the minimum transaction units in the studied context. Each reverse auction consists of one or more lots and each lot consists of a single type of object.

Regarding the choice of Organization X to carry out the research, it is important to emphasize the difficulty to collect data on performance outcomes of government procurement in Brazil. Despite the advances made by online procurement platforms, transparency about events that occur after the selection of the supplier is still limited. In this sense, in view of the absence of systematized public records available electronically for consultation, the collection of data on the ex-post performance of the contracts was only possible through an in-situ and on-site documentary search in different units of the researched organization, in order to access invoices and fiscal receipts of the transactions.

In addition to the fiscal receipts, five different sources of data were used in the documentary research: Comprasnet, Unified Supplier Registration System (Sicaf), Federal Revenue Service (RF), Integrated System of Assets, Administration and Contracts (Sipac) and Transparency Portal (PT). In Comprasnet, using the minutes of the procurement process, collected information about the specification of the standardized lot, the estimated amount for the lot, the outcome of the procurement (adjudicated, revoked or the absence of suppliers interested), the cost of the bid contracted and the National Register of Legal Entity (CNPJ) of the chosen company. The study collected information on the date of registration of the company contracted as well as the history

of sanctions received by the company in Sicaf. The Federal Revenue Service was the source of information about the age, location and size of the contracted company. Sipac offered information on the date of entry of the objects in Organization X's warehouse, between January 2014 and September 2015, and the number of the commitment invoice with the request for the purchased objects. The information collected in Sipac complements the data obtained in the fiscal receipts, which were collected through the on-site research in different units of Organization X. Finally, in the Transparency Portal, all the commitment invoices issued in 2014 and 2015 by Organization X regarding the request for consumables were collected.

4.1 PERFORMANCE VARIABLES

The study used two dependent variables. The first, "price reduction", measures the variation in contracted prices compared to the amounts previously estimated for acquisition. The choice of this variable is justified as the concern about the use of the taxpayer's money and the search for the best price in government procurement are some of the main reasons for the government procurements (Bajari, Mcmillan and Tadelis, 2009). The second variable refers to the delivery lead-time, which is an important objective of procurement processes. In electronic procurement, unjustifiable delays in delivery are among the most common forms of opportunistic behavior presented by suppliers (Ba and Pavlou, 2002). The variable "delivery time" corresponds to the number of days elapsed between the issuance of the commitment invoice with the request for the contracted object, until it is received by the organization.

4.2 EXPLANATORY VARIABLES

The hypotheses of the study were tested using five variables. The effects of the competitive environment were analyzed through the variables "suppliers" and "price reduction". The first variable indicates the number of suppliers that participated in the procurement process. This variable is intended to capture the effect of competition among bidders on the performance of the procurement in terms of price reduction. The "price reduction" variable, already defined above, was also used to verify to what extent the savings achieved in the procurement process can influence the ex post performance of the contract, in terms of delivery time. The effects of the capabilities accumulated by the supplier were evaluated based on the variables "market experience" and "experience with the public sector". The first variable represents the number of years that the contracted company has been active in the market since it was established. The second indicates how long the company is a government supplier (measured by the number of years the firm is registered in Sicaf). Finally, the reputation effect was analyzed through the variable "history of sanction", a variable that indicates the number of sanctions that the supplier received in previous contracts with the organization researched.

4.3 CONTROL VARIABLES

The study used a set of control variables that can influence the performance dimensions of electronic procurement. One variable related to the size of the lot object of bid, measured by the "estimated

amount” for the purchase of each lot; two variables related to the size of the contracted company (dummy equal to 1 if micro and small enterprise (MSE) was contracted) and geographic “distance” between the supplier and the buyer organization (in kilometers). Seven other dummies were considered, characterizing the contracted items: office supplies – baseline, cleaning products, food, kitchen material, safety and protection material, electrical material and others).

4.4 EMPIRICAL STRATEGY

From the point of view of the statistical analysis, considering the characteristics of the performance variables investigated, two different regression models were used. Firstly, a regression model of ordinary least squares (OLS) was adopted. Such method is widely used in research on government procurement (Bajari, Mcmillan and Tadelis, 2009). However, considering that the estimates of this model are sensitive to the presence of outliers and its application requires a rigorous verification of premises and adjustments in order for the estimates to be valid (Wooldridge, 2006), a model of quantile regression was used in a complimentary fashion.

Differently from the OLS technique, the quantile regression allows the analysis of the impact of explanatory variables at different points of the conditional distribution of the dependent variable (quantiles). Thus, the use of quantile regression allows capturing the sensitivity levels of the dependent variables for different strata of the dataset. This enabled the analysis of the results for lots at extreme points of the sample, in our dependent variables. To run the quantile regressions, the base was divided by quartiles. The lots that obtained the lowest reduction in contracted prices and shorter delivery times (q25) are in the first quartile (q25 - referring to 25% of the lots that presented less savings and shorter delivery time) and those with the greatest reduction and longer delivery time are located in the third quartile (q75). Although this technique is less widespread in the field of public administration, it can be seen as an extension of the OLS, with the advantage of allowing a more accurate analysis, due to its robustness in face of the majority of the drawbacks observed in the OLS models (Bretschneider, Marc-Aurele Jr. and Wu, 2005).

5. RESULTS AND ANALYSIS

Table 1 presents the descriptive statistics of the variables used in the study. The sample consists of 3,755 standardized lots procured in on-line reverse auctions, of which 88.4% (3,321) were adjudicated to a supplier. Among the non-adjudicated contracts, approximately 65.2% of the cases were related to prices above that estimated, and 16.8% occurred due to the absence of suppliers interested in participating in the procurement process.

Among the adjudicated contracts, there is a high degree of heterogeneity in the savings obtained in the procurement processes and in the delivery time. Surprisingly, an acquisition of laboratory material with a unit price estimated at R\$ 0.11 was made for R\$ 0.49, which represented a loss of 345.45% to the public budget in relation to the amount predicted in the planning stage. On the other hand, a purchase was verified for chemical material with an estimated unit price of R\$ 25.05, but with an adjudicated price of R\$ 0.05, which is equivalent to a reduction of 99.8%. Despite these differences, the average economy observed in the sample was 22.2%, which is close to the national average in

the last seven years, which oscillated between 18% and 24% (Brazil, 2015). In terms of delivery lead-time, it is observed that the waiting time between the request of the material and its delivery was, on average, 28 days. This result, a priori, should be interpreted with caution, given that, in general, public-bidding calls establish a delivery time of 15 to 30 days after the issuance of the commitment invoice. In addition, it is worth mentioning that 31.1% of the deliveries researched were carried out with a deadline of more than 30 days.

TABLE 1 DESCRIPTIVE STATISTICS

Variables	N	Mean	Standard Deviation	Minimum	Maximum
Dependent					
Price reduction	3,321.00	22.20	26.07	-345.45	99.80
Delivery time	283.00	27.55	13.80	1.00	66.00
Explanatory					
Suppliers	3,755.00	5.83	4.42	0.00	41.00
Market experience (years)	3,321.00	11.06	8.40	0.13	48.45
Experience with the public sector (years)	3,321.00	6.24	4.30	0.05	18.99
History of sanctions	3,321.00	1.14	1.97	0.00	10.00
Control					
MSE	3,321.00	0.80	0.40	0.00	1.00
Distance (km)	3,321.00	1,038.37	1,029.48	5.60	3,247.00
Estimated amount (R\$)	3,755.00	38,017.14	279,854.00	3.80	5,625,000.00
Type of material					
Office supplies – <i>baseline</i>	3,755.00	0.26	0.44	0.00	1.00
Cleaning products	3,755.00	0.07	0.25	0.00	1.00
Food	3,755.00	0.23	0.42	0.00	1.00
Kitchen materials	3,755.00	0.05	0.21	0.00	1.00
Safety and protection	3,755.00	0.04	0.21	0.00	1.00
Electric material	3,755.00	0.03	0.16	0.00	1.00
Others	3,755.00	0.33	0.47	0.00	1.00

Source: Research data.

About the variable “delivery time”, it should be noted that in the documentary research carried out in the entry reports of the organization’s warehouse and in the purchase’s fiscal invoices it was

possible to identify the date of entry for only 325 lots, which correspond to approximately 10% of the lots in the sample. In addition, it is important to observe that most of the commitment invoices issued in November are not sent to suppliers until the next year. They have the exclusive purpose of guaranteeing that those committed funds will stay under the organization's control and will not return to the National Treasury. Therefore, it was necessary to exclude from the analyzes the deliveries with commitment invoices issued in November considering that, since they are sent to suppliers only the following year, the calculation of the "delivery time" based on the commitment invoices issued in November would be overestimated.

Regarding explanatory variables, the data demonstrate a limited number of suppliers in the dispute. On average, there were 5.8 competitors per lot, with 37.7% of the lots being disputed by a maximum of three suppliers, which is the minimum number of competitors to justify the use of electronic contracting (Yukins and Wallace Jr., 2005). Concerning the accumulated capabilities, it is possible to observe that the suppliers have, on average, more than 11 years of operation in the market and have been registered for about six years in the Sicafe. As far as reputation is concerned, on average, each supplier has at least one sanction for unsatisfactory performance in previous transactions with the organization researched, with 43.6% of suppliers having been sanctioned at least once by the organization.

Table 2 below presents the results of the estimated regressions. Two models were estimated by OLS (1 and 5) and six models by quantile regression (2 to 4 and 6 to 8). The models 1 to 4 allow identifying the factors associated with the reduction in the prices tendered, while the models 5 to 8 allow verifying the factors associated with the reduction of delivery times, as well as if there is a significant association between the savings obtained in the procurement process and the delivery times.

TABLE 2 DETERMINANT FACTORS OF ELECTRONIC PROCUREMENT PERFORMANCE

	Price reduction				Delivery time			
	OLS	Quantile			OLS	Quantile		
	(1)	(2) q25	(3) q50	(4) q75	(5)	(6) q25	(7) q50	(8) q75
Competitive environment								
Price reduction					0.009 (0.040)	0.004 (0.016)	0.006 (0.025)	0.010 (0.035)
Suppliers	2.488*** (0.140)	1.920*** (0.113)	3.192*** (0.142)	3.761*** (0.238)	-0.566** (0.262)	-0.187 (0.203)	-0.098 (0.259)	-0.107 (0.312)
Accumulated Capabilities								
Market experience	0.114** (0.057)	0.054 (0.036)	0.143** (0.068)	0.135 (0.117)	0.013 (0.124)	0.035 (0.284)	0.098 (0.120)	0.220 (0.232)
Experience with the public sector	0.051 (0.127)	-0.059 (0.079)	-0.198 (0.163)	0.059 (0.211)	-0.321 (0.342)	0.375 (0.536)	0.043 (0.377)	-0.443 (0.637)
Reputation								
History of sanctions	-1.079*** (0.236)	-0.017 (0.089)	-0.657** (0.311)	-1.661*** (0.423)	3.003*** (0.570)	2.851*** (0.752)	3.597*** (0.560)	4.332*** (0.939)
Control								
MSE	-4.601*** (1.237)	-0.820 (0.819)	-5.301*** (1.762)	-4.382** (2.003)	9.779*** (2.308)	12.635*** (4.421)	14.104*** (3.400)	15.172*** (2.756)
Log (Distance)	0.403 (0.248)	0.254* (0.148)	0.447* (0.244)	0.321 (0.457)	3.031*** (0.773)	3.191** (1.331)	1.432 (1.447)	2.115 (1.594)

Continue

	Price reduction				Delivery time			
	OLS	Quantile			OLS	Quantile		
	(1)	(2) q25	(3) q50	(4) q75	(5)	(6) q25	(7) q50	(8) q75
Log (Estimated amount)	0.150 (0.272)	-0.003 (0.058)	-0.207 (0.191)	0.761 (0.482)	0.301 (0.647)	-0.286 (0.498)	-0.016 (0.505)	0.150 (0.685)
Type of material								
Cleaning products	-3.515** (1.707)	-2.822*** (1.078)	-1.522 (1.878)	-2.003 (3.163)	2.610 (4.128)	2.582 (6.778)	-4.403 (6.396)	2.610 (4.128)
Food	3.998*** (1.358)	3.899*** (0.771)	3.314*** (1.077)	4.079 (2.659)	-0.119 (4.441)	2.240 (8.046)	-5.517 (8.517)	-0.119 (4.441)
Kitchen materials	-6.535*** (2.008)	-4.106** (1.648)	-5.099** (2.104)	-4.526 (5.160)	1.570 (4.907)	3.068 (8.036)	-7.813 (6.826)	-15.006 (9.930)
Safety and protection	1.015 (1.790)	2.835*** (0.920)	2.683 (2.135)	3.612 (3.482)	4.906* (2.883)	10.410** (5.107)	4.292 (3.837)	-2.347 (4.613)
Electric material	0.631 (2.011)	0.969 (2.485)	3.716* (2.241)	-3.472 (3.188)	11.445*** (3.191)	9.105 (7.602)	18.024*** (6.730)	6.364 (4.491)
Others	6.813*** (1.260)	3.297*** (0.802)	7.850*** (1.543)	12.568*** (1.869)	3.273 (3.158)	7.167* (4.008)	5.232 (3.937)	-2.509 (3.884)
Constant	4.314 (3.096)	-7.970*** (1.737)	-2.292 (3.405)	0.015 (4.424)	4.926 (6.274)	-9.594 (7.516)	6.218 (8.490)	11.718 (7.962)
N	3,318	3,318	3,318	3,318	283	283	283	283
F Test	66.80***				7.98***			
R2/Pseudo R2	0.241	0.117	0.218	0.175	0.248	0.247	0.236	0.249

Notes: Parentheses are used to indicate robust standard errors *** p<0.01, **p<0.05, * p<0.1.

Source: Research data.

5.1 EFFECTS OF THE COMPETITIVE ENVIRONMENT

As can be seen, in model 1, an increase in the number of suppliers has a positive effect, on average, of 2.4% in the savings achieved. Likewise, in models 2, 3 and 4, it can be seen that the quantile regression allowed a more detailed analysis of the effects of the number of suppliers on contracted prices, as the results reveal increasing coefficients in all quartiles. These results are in line with the first hypothesis of the research and corroborate previous studies carried out by authors such as Croom and Brandon-Jones (2007) and Reis and Cabral (2015), who advocate for the reduction of entry barriers and the increase in the number of competitors as a strategy to promote improvements in savings for the government.

The results presented in models 5, 6, 7 and 8 indicate that “price reduction” has no significant effect on the delivery time. These results do not support the second hypothesis of the study. However, it is worth noting that this result does not mean that the tightening of competition and the reduction in bid prices are not a potential problem for the ex post performance of government electronic procurement, when it is recognized that logistical decisions are subject to the trade-offs that include cost; quality; agility; positive or negative externalities (Vaz and Lotta, 2011). Thus, it is possible that problems arising from very low bids and opportunistic behavior on the part of suppliers, act on other dimensions of performance, such as deviations in the quality of the object or in the specifications contracted, and even in terms of withdrawal from the contract, so that they are not related to the performance proxy adopted in this study.

Moreover, it is likely that many public managers are not equipped with sufficient technical knowledge and resources to monitor procurement's ex post performance due to the volume and diversity of items involved. Illustratively, perhaps, the constraints experienced in the data collection phase in order to obtain the date of the deliveries, are evidence of the problems faced by the contracting

organization to control and oversee their purchases. Taking advantage of these limitations, suppliers can act opportunistically by offering products of lower quality or even with specifications different from those set forth in the public bidding notice, thus hampering the performance of government procurement, as pointed out by Ba and Pavlou (2002) and Faria and collaborators (2010b). Therefore, the results presented here reinforce the need for more in-depth research that empirically investigates the determinants of the government procurement performance in its multiple dimensions.

5.2 EFFECTS OF ACCUMULATED CAPABILITIES

As for the effect of the accumulated capabilities, the result obtained in the OLS model shows that, on average, the greater the company's market experience, the greater its capability to obtain price reductions ($p < 0.05$). In the quantile regression, it is verified that the market experience is only significant in the second quartile (q50). In fact, given the heterogeneity of the data, the use of the quantile regression allowed for a more robust and detailed analysis, which could not be observed in the OLS regression. Thus, the third hypothesis of the study, which points out the importance of the experiences accumulated by the suppliers to improve the prices practiced, is supported only in the model by OLS and in quartile (q50).

As for the absence of effect in the upper quartile, it may be assumed that more experienced suppliers are less likely to engage in aggressively lower bidding disputes, which would lead to high price reductions. Likewise, for the lower quartile, an anecdotal explanation would be that the lower savings achieved in the procurement process stems from a misleading definition of the estimated value for the object tendered during the planning phase, i.e., an underestimation of the price for the lot. It would be likely that the suppliers with more experience would not participate in a bid in which the estimated price is undervalued, not accepting a lower profit than the one that could be obtained in an alternative bid (Tadelis, 2012).

In terms of delivery lead-times, although the proposed hypothesis establishes a positive relationship between the experiences accumulated by the supplier and the agility to deliver, it seems that the supplier's experience operating in the market and public sector does not seem to influence the delivery time. Therefore, the results obtained do not support the fourth hypothesis of the study.

5.3 REPUTATION EFFECTS

Regarding the reputation effects, the results reported in models 1, 3 and 4 show a negative association between the history of sanction for suppliers' poor performance and the economy obtained in the bid. Models 5 to 8 also show that suppliers with poor performance are associated with longer delivery times ($p < 0.01$). These results demonstrate that reputation-based incentive mechanisms commonly used in online private shopping platforms (Ba and Pavlou, 2002; Spagnolo, 2012) do not seem to be effective in the Brazilian context. This is because the reputation proxy used shows that suppliers with penalties in previous contracts are precisely those that present a longer delivery time, which supports the fifth hypothesis of the study.

These results have at least two possible interpretations. First, from the experience accumulated over time, suppliers that operate with public organizations and have a history of sanctions may

have identified that penalties for delays are not likely to be enforced, particularly when it comes to procurement of less complex and of frequent consumption items. Secondly, these same suppliers probably realized that the costs imposed by the sanctions usually applied may be lower than the gains obtained by delayed delivery. Hence, suppliers would have little incentive to ensure speed of delivery.

Regarding the low costs allegedly associated with the sanctions, it is important to note that, unlike other online platforms, such as eBay and Freelancer.com, for public biddings, the records related to the performance history are not used as a criterion to pre-qualify suppliers or to rank them for future procurement. Therefore, given the low expectation of subsequent gains due to a reliable reputation, the contractual sanctions set forth in public notices for electronic public procurement have proved incapable of directing the behavior of suppliers. However, despite the results pointed out in this and other studies, such as Spagnolo (2012), lawmakers responsible for formulating and reforming public procurement regulations are still reticent about the implications of reputation-based governance mechanisms on the number of competitors entering in public bidding; on the isonomic treatment of suppliers; and on the need to avoid favoritism and corruption in bidding processes.

Chart 1 below summarizes the main results obtained for each of the hypotheses of the study.

CHART 1 SUMMARY OF RESULTS

Hypotheses	Results
<i>H1: The greater the number of competitors in government electronic procurement, the greater the savings in prices contracted.</i>	Supported
<i>H2: The greater the savings obtained in the electronic procurement, the longer the delivery time of the object contracted.</i>	Not supported
<i>H3: The greater the capability accumulated by the awarded company, the greater the savings in the prices contracted.</i>	Supported only in models 1 (MQO) and 3 (q50)
<i>H4: The greater the capability accumulated by the awarded company, the shorter the time to deliver the contracted object.</i>	Not supported
<i>H5: The greater the history of poor performance of a supplier, the longer the time to deliver the contracted object.</i>	Supported

Source: Research data.

6. CONCLUSION

6.1 IMPLICATIONS FOR THEORY AND PRACTICE

From a practical point of view, the research findings open room for a more in-depth discussion about the behavior of suppliers contracted through electronic procurement and the use of new governance

mechanisms that stimulate the construction of a reliable reputation on the part of these suppliers. For government procurement managers, the positive effect of the number of suppliers on the bid price reinforces the importance of investments in contracting mechanisms, such as electronic procurement platforms, which increase advertising of public bidding notices and reduce barriers facilitating the entrance of new participants.

For policymakers and the agencies responsible for planning, overseeing, and regulating government procurement, the study contributes showing the need to explore the potential of online procurement platforms in order to improve monitoring and control activities in the execution and evaluation phase of the acquisition. Such a strategy would help address the scarcity of information on other performance measures and the difficulty of accessing existing measures, extending the analysis to the other phases of the supply chain.

At the same time, the study highlights the importance of setting up manuals containing best practices for the formulation of public bidding calls or standardization of products, since 11.6% of the lots tendered were not awarded, due to the absence of suppliers interested in contracting or the bids were above the buyer's estimated values. In addition, the definition of such good practices could reduce the cases in which the savings reached levels that transcend reasonability, such as reductions in bid prices above 90% ($n = 31$).

From the theoretical point of view, the study contributes to previous research in the field of government procurement, by analyzing the determinants of government procurement performance in different performance dimensions, and analyzing the trade-off between costs and other quality measures. (Tassabehji et al., 2006; Tridapalli, Fernandes and Machado, 2011; Vaz and Lotta, 2011; Freitas and Maldonado, 2013). In addition to providing empirical evidence on the role of suppliers' reputation on performance dimensions in government procurement, the research contributes to the theoretical debate about the importance of governance mechanisms in government procurement processes (Spagnolo, 2012) and the importance of factors related to accumulated capabilities in business-government relationships (Cabral, 2017).

6.2 RESEARCH LIMITATIONS

As for the limitations of the study, first it is important to emphasize that the research is limited to a single organization and adopts an essentially descriptive empirical analysis, providing evidence only of an association between variables, and does not intend to attribute causality. Thus, the usual warnings about the possibility of generalization and external validity of this research should be observed. Second, the impeditive factors encountered in the data collection phase and the lack of records on some important performance measures prevented the inclusion of other logistic trade-offs in the analyzes carried out, such as costs vs. quality (specified and/or perceived) and costs vs. conformity, as well as the expansion of the database with the inclusion of information from other agencies of the federal administration.

Thirdly, it is worth highlighting that the focus on the purchase of consumables may be a possible explanation for the absence of a negative effect of the savings obtained in the bidding phase on the ex post procurement performance, since the effects of the price reductions during the bidding phase may be more expressive in contracts for services. Notably, although several types of services contracted

through electronic procurement are considered ordinary, that is, of low specificity, they are subject to uncertainties that may not be observed in the procurement of consumables. Faced with these limitations, the importance of additional data sources is clear. However, this article constitutes an important step towards the consolidation of lines of research aimed at producing robust analyzes on the determinants of performance in electronic procurement.

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