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Article

The relationship between performance and the dimensions of the Brazilian Federal Revenue Service's procurement structure

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This article investigates the performance of the Brazilian Federal Revenue Service's (FRS) procurement function from the perspective of the dimensions of its organizational structure. Using data collected from the FRS, the methodological strategy consisted of summarization and regression techniques, identifying variables linked to the centralization, formalization, and specialization of the procurement structure, and the relationship of these elements with its performance. The results indicated significant and positive relationships between centralization and time-related performance measures. In contrast, occupational specialization at intermediate levels was negatively associated with competition, while accumulated experience in the procurement area was positively associated with bidding times. Formalization showed associations that indicate a trade-off between financial resources and time. Consequently, the research contributes to the field of public administration by investigating the structure and performance of procurement in a Brazilian institution with national operations, looking into gaps identified in national and international articles, such as those related to the country, scope, and diversity of the purchases analyzed, and interpreting the causal aspects of these associations.
Keywords: structure; public procurement; performance.

Explorando a toca do leão: dimensões da estrutura de compras e sua associação com o desempenho da função na Receita Federal do Brasil

Este artigo investiga os fatores referentes ao desempenho da função de compras da Receita Federal do Brasil (RFB), sob a perspectiva de dimensões de sua estrutura organizacional. Para tanto, a estratégia metodológica consistiu no levantamento de dados da RFB. Por meio de técnicas de sumarização e regressão, identificaram-se variáveis associadas à centralização, à formalização e à especialização da estrutura de compras, bem como suas relações com o desempenho da função na instituição. Os resultados indicaram relações significativas e positivas entre centralização e medidas de desempenho relativas ao tempo. Em contraste, a especialização ocupacional, em níveis

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intermediários, se associou de forma negativa com a competição, enquanto a experiência acumulada na área de compras se associou positivamente com os prazos de licitação. A formalização, por sua vez, apresentou associações que indicam um *trade-off* entre recursos financeiros e tempo. Consectuvamente, a pesquisa contribui para o campo da administração pública ao investigar a estrutura e o desempenho em compras numa instituição brasileira com atuação nacional, perscrutando hiatos identificados em artigos nacionais e internacionais, como os relativos ao país, à abrangência e à diversidade das compras analisadas, interpretando aspectos causais dessas associações.
Palavras-chave: estrutura; contratações públicas; desempenho.

Explorando la guarida del león: dimensiones de la estructura de compras y su asociación con el desempeño de la función en la Hacienda Nacional de Brasil

Este artículo investiga los factores relacionados con el desempeño de la función de compras de la Hacienda Nacional de Brasil, desde la perspectiva de las dimensiones de su estructura organizativa. Para ello, la estrategia metodológica consistió en recoger datos de la Hacienda Nacional. Mediante técnicas de síntesis y regresión, se identificaron variables vinculadas a la centralización, formalización y especialización de la estructura de compras, así como su relación con el desempeño de la función en la institución. Los resultados indicaron relaciones significativas y positivas entre la centralización y las medidas de desempeño relacionadas con el tiempo. Por el contrario, la especialización ocupacional en niveles intermedios se asoció negativamente con la competición, mientras que la experiencia acumulada en el área de compras se asoció positivamente con los tiempos de licitación. La formalización, por su parte, mostró asociaciones que indican una compensación entre recursos financieros y tiempo. Consecutivamente, la investigación contribuye al campo de la administración pública al investigar la estructura y el desempeño de las compras en una institución brasileña con operaciones nacionales, examinando las lagunas identificadas en artículos nacionales e internacionales, como las relativas al país, al alcance y a la diversidad de las compras analizadas, e interpretando los aspectos causales de estas asociaciones.
Palabras clave: estructura; contrataciones públicas; desempeño.

1. INTRODUCTION

The interest in the ways in which organizations divide and coordinate their activities in dimensions associated with centralization, formalization, and specialization is not novel in the field of Administrative Science (Andrews et al., 2009), considering the relevance of decisions regarding the organizational structure to achieve quality performance (Mintzberg, 1979). However, there is no consensus on the best way to organize or which organizational structures lead to better performance (Patrucco et al., 2019).

In the more specific context of the "procurement" function, despite the limits imposed by the laws that regulate bidding and public contracts, mostly oriented towards procedural compliance, and the organizational fragility that has characterized this area in Brazil (Fernandes, 2016), many public organizations have devoted attention to decisions on how to organize their contracting activities in terms of centralization, formalization, and specialization (Porta et al., 2022).

Even though these decisions represent an opportunity for the development of research that seeks to understand the association between organizational structure and performance, there are few studies on the topic, both internationally and in Brazil. Recent studies have highlighted the need for research that provides empirical evidence on the effects of the organizational structure of contracting on the performance of this function. Patrucco et al. (2021), when investigating the performance of municipal units in Italy and the United States, have suggested further work on procurement structures of national organizations. In turn, Petersen et al. (2022), when evaluating centralized purchases of a specific object in the Danish government, have proposed studies with a broader scope and conducted in other countries.

Among the few Brazilian articles in the area, the study by Fernandes (2016) stands out. It presents

a history of the organization of procurement and contracting structures within the federal public administration from the 1930s to the first two decades of the 21st century. Similarly, Almeida and Sano (2018) sought to associate the evolutionary stage of the structure and organization of the procurement sector of a specific unit, within the scope of the federal government, with the speed of contracting deadlines in the auction modality. The conclusions of these studies highlight the challenges of organizational structuring in this area (Fernandes, 2016) and the limitations that the structure imposes on contracting performance (Almeida & Sano, 2018).

Empirically, this text contributes to the Receita Federal do Brasil (RFB) strategic objectives, especially in the context of management changes determined by Law No. 13,464/2017, which demands optimal levels of performance from the institution. It also adds to the historical evolution of the procurement function in the organization, as registered in the last three internal regulations (MF Ordinances No. 203/2012; 430/2017; 284/2020), which is increasingly moving towards greater levels of centralization, formalization, and specialization.

In this way, we sought to answer the following research problem: how are the dimensions of centralization, formalization, and specialization of the procurement structure associated with performance indicators of this function in the context of the RFB? To answer this, a random sample of 360 procurements carried out by the RFB was examined, through different procedures, in the years 2018 and 2019. The justifications for selecting the RFB as the *locus* and the chosen time frame consider the following factors: large volume of purchases and contracts carried out; relevance of the institutional mission for the federal public administration; operations across the entire national territory, via local, regional, and central units; and, especially, variability in intraorganizational procurement strategies that the organization adopted from the end of 2017, with different levels of centralization, formalization, and specialization.

The results corroborate mixed associations between the performance of the procurement function and aspects of both centralization and formalization. However, there are characteristics of the level of specialization that were positively associated with procurement performance. The research results cannot be generalized to other public services; however, they offer three contributions to the field of public administration, specially to the field of public procurement and contracting.

Firstly, it responds to the demand in the national literature for empirical evidence linking dimensions of the procurement structure with various performance indicators, complementing the studies by Almeida and Sano (2018), Fernandes (2016), and Porta et al. (2022). Despite these studies highlighting the relevance of the structuring, they did not delve into the analysis of the relationship between structural aspects – centralization, formalization, and specialization – and their impact on performance.

Secondly, it differs from other studies that have examined the factors associated with the performance of public procurement (Araújo et al., 2020) and that, until now, have been limited to analyzing behavioral and transactional attributes (Cabral, 2007; Faria et al., 2010), legal changes (Reis & Cabral, 2015), the role of the public buyer (Batista & Maldonado, 2008), organizational and individual competencies or capacities in public and private contracting (Bonelli & Cabral, 2018; Reis et al., 2023), in addition to the instrumental rationality that predominates in the activity (Cardoso & Mueller , 2020) and the influence of stakeholders (Rodrigues & Reis, 2023).

Finally, by associating strategic choices involving different dimensions that characterize the

structure of the procurement function and its performance, the article contributes with recent demands for a greater integration between fields such as Public Administration and Strategy in Organizations (Cabral et al., 2015; Glas et al., 2017).

2. THEORY AND HYPOTHESES

2.1 Performance in public procurement

Although studies on performance face challenges related to different definitions and uses of the term, difficulties in measurement, and potential conflicts between various measures and stakeholders they represent (Misoczky & Vieira, 2001; Rodrigues & Reis, 2023), the concern with improving public services has driven research into the factors associated with the performance of public organizations (Andrews et al., 2006). This research also reached the area of public procurement and contracting, given the potential of these activities to achieve strategic objectives of organizations (Patrucco et al., 2016, 2021) and their importance in addressing situations of emergency, as was evident in government responses to the COVID-19 pandemic (Rutkowski et al., 2022).

As Glock and Broens (2011) and Petersen et al. (2022) highlight, the contribution of procurement to the functioning of any public organization is evident. The quality of goods and services purchased impacts the quality of services provided to the population, whereas potential financial savings from contracting processes can, eventually, free up additional resources to fund other relevant activities within public organizations.

In this context, despite the multidimensional nature of performance, several studies have defended the need for its management and monitoring in public organizations, including specific functions such as procurement (Patrucco et al., 2016). These studies employ different measures to express the performance of contracting across the dimensions of efficiency, efficacy, and effectiveness (Fernandez, 2007; Reis, 2015).

Efficiency, for example, includes variables related to the reduction in contracted prices (Faria et al., 2010) or the difference between the amounts paid in procurement and those spent on public provision (Cabral & Lazzarini, 2010). These measures have been a priority in public procurement (Cardoso & Mueller, 2020; Inamine et al., 2012), primarily due to the fiscal restrictions of most governments and the emphasis on controlling public expenditure, which has been a consistent focus in Brazil over recent decades, regardless of the political parties in power.

Efficacy, on the other hand, encompasses measures related to achieving the desired results from procurement (Cabral & Lazzarini, 2010) after the bidding phase, during execution and delivery of the contract, such as deadlines (Almeida & Sano, 2018; Reis & Cabral , 2018), legal compliance in contract execution (Reis & Cabral, 2015; Bonelli & Cabral, 2018), and the implementation of public policies that use government purchasing power to achieve specific objectives, such as support for micro and small companies (Reis & Cabral, 2015).

Measures of effectiveness, in turn, are difficult to quantify and, thus, are rarely used (Patrucco et al., 2016; Rodrigues & Reis, 2023). These measures involve broader aspects, such as the goal of encouraging innovation and sustainable national development, as expressed in the new public procurement and administrative contracts law (Law No. 14,133/2021), as well as other objectives related to the organization's core activity and the creation of public value (Cabral et al., 2015; Inamine et al., 2012).

Brazilian national studies analyzing the factors associated with performance measures in public procurement have been based on various approaches and theories. Faria et al. (2010) adopted auction theories and the transaction cost theory to demonstrate the effects of competition on the efficiency of public bidding – specifically, the reduction of prices in electronic auction modality. Cabral and Lazzarini (2010), in turn, based on agency theory and the premises of the agent-principal relationship, as well as the incentive theory, analyzed the impact of outsourcing on the reduction of amounts spent on services provided to the prison population.

Other studies, such as those by Bonelli and Cabral (2018) and Cabral et al. (2015), analyzed the impacts of public and private skills on the cost and efficacy of procurement. Reis and Cabral (2018) and Reis et al. (2023), in turn, have verified the efficacy of procurement in terms of speed of delivery and completion of contracting processes. While the first used the relational approach, which emphasizes the role of reputation as a crucial element for improving performance in a context of repeated interactions and information asymmetry (Spagnolo, 2012), the second adopted the notion of organizational inertia to explain how more experienced buying agents can reduce procurement performance in a context of conflicting objectives and audit explosion.

These studies reveal that there is no theory or approach that alone can explain the performance of public contracts, which is influenced by several factors, such as competition, transaction costs, incentive structures, stakeholders, managerial skills, and organizational structure. While the first factors have received considerable attention in studies, organizational structure remains an aspect scarcely explored in international (Patrucco et al., 2019) and national literature. The exception are the studies by Fernandes (2016, 2019) that have highlighted a historical fragility in the structure and institutionality of the procurement and contracting area in Brazil, and by Porta et al. (2022), who highlighted the possibilities of centralization within specific government departments. The work by Almeida and Sano (2018) is one of the few that analyzed the impact of the structure of organization and the procurement sector on the speed of auctions carried out by a federal government procurement unit.

2.2 Procurement area structure and performance

Studies that investigate the ways in which organizations divide and coordinate their activities, in dimensions related to centralization, formalization, and specialization, are not new in the field of Public Administration (Andrews et al., 2009). Regarding public procurement and contracting, concerns with aspects of the organizational structure have been a recent discussion in specialized literature (Fernandes, 2016; Patrucco et al., 2021) and international organizations, such as the Organization for Economic Cooperation and Development (OECD) and the European Union (EU), which have encouraged the centralization of procurement as a means of aggregating public demand and exploring economies of scale (Dimitri et al., 2006; Petersen et al., 2022).

The importance of the procurement structure assumes even greater relevance given the restrictions imposed by legislation, as public managers have some discretion to manage and configure the procurement structure to support the achievement of expected performance (Fernandes, 2019; Porta et al., 2022). However, even if it is not possible to establish an ideal structure to be applied (Patrucco et al., 2021), the performance of a specific activity or unit, such as the public procurement function, can be improved based on the configurations chosen for each dimension.

2.2.1 Centralization and performance

The decision between centralizing or decentralizing procurement is probably one of the main and most frequent (Petersen et al., 2022), with emphasis on centralized procurement agencies in European countries (Dimitri et al., 2006). In the case of Brazil, we can mention the Brazilian Price Registration System (SRP), which operationalize centralized procurement strategies via demand aggregation (Fernandes, 2019). Still in the national context, the experiences of creating central units dedicated to implementing a government procurement policy stand out, such as the Procurement and Contracting Center of the Brazilian Ministry of Economy and the Brazilian Hospital Services Company (Porta et al., 2022).

Regarding the centralized procurement structure, the focus of our study, which is not to be confused with the centralization/aggregation model adopted in the SRP, Patrucco et al. (2019) characterize it as the delegation of responsibility to a single organization, department, or central unit to bid for items and services that will meet the demands of different requesters, from different units to different organizations. On the other hand, decentralized procurement is an arrangement that allows each organization, department, or unit to have its own structure to bid for goods and services in demand.

In the specific scope of this study, as the RFB is an organization with a physical presence across all states of Brazil, its structure is divided and coordinated at different hierarchical levels. Its strategic apex is the central departments (national procurement), with 10 intermediate managements (regional purchasing), and 100 decentralized units (local procurement). Until 2017, the RFB had a decentralized procurement model, which was carried out by local units. However, as of MF Ordinance no. 430/2017, there has been the implementation of a more centralized, or regionalized, administrative model, which accumulates procurement demands in regional units and, to some extent, expand to the centralization of the procurement process. Not infrequently, regional units serve to satisfy similar needs, grouping them into a single contract and configuring the adoption of a procurement regionalization strategy, that is, greater centralization, compared to the local ones.

Bringing theoretical and practical arguments in favor of centralization, Karjalainen (2011) and Petersen et al. (2022) highlight its capacity to promote efficiency by reducing direct and indirect costs of the contracting process (Glas et al., 2017; Porta et al., 2022). These advantages could be obtained through economies of scale – resulting from bargaining power with suppliers –, process savings, with the reduction of administrative costs, and informational economies, built with the accumulation of specialized knowledge and increased contracting capacity, among others.

On the other hand, Petersen et al. (2022) also present disadvantages of centralization, which might potentially hinder the efficacy of procurement due to the distance between the procurement structure and the contracting plaintiff, as well as communication and priority definition problems, delays and failures in deliveries, in addition to market concentration, among others.

Based on these considerations, as pointed out by Andrews et al. (2009) and Patrucco et al. (2021), the decision in favor of centralization may have inconsistent, contradictory, or non-significant effects on procurement performance, which results in the formulation of the following hypothesis: "Higher levels of centralization of the procurement structure are associated with mixed performance results of the function" (H_1).

2.2.2 Formalization and performance

Formalization or standardization is a predominant characteristic in public organizations and, particularly in public procurement, it concerns the standards of behavior and procedures to be followed when conducting contracts, via written standards and procedures (Andrews, 2010; Patrucco et al., 2019). The main objective of formalization is to ensure compliance with procedures by defining standardized procedures based on lessons learned (DeHart-Davis et al., 2013). As a result, it is expected that a higher level of formalization can facilitate the monitoring of activities, prevent behavior that is not directed towards the contractor's institutional objectives, and reduce the uncertainty of the actors involved, promoting greater levels of transparency and accountability.

The degree of formalization has been widely debated, and studies have presented mixed results on its relationship with the performance of organizations (Kaufmann et al., 2019) and public procurement (Patrucco et al., 2021). Moreover, critics of formalization and centralization argue that excess of the former reduces flexibility and opportunities for innovation, evoking an association between written rules and inefficiency (DeHart-Davis et al., 2013), which hinders the performance of organizations (Andrews, 2010). Based on these arguments, we have the following hypothesis: "Higher levels of formalization in public procurement are associated with lower performance" (H_2).

2.2.3 Specialization and performance

Specialization, in general, refers to the division of work in the organization, in which tasks tend to be segmented and simplified. Thus, specialization is a path to increasing productivity in organizations (Mintzberg, 1979). Organizations that show more dedication to this process tend to hold a greater number of different occupations in its staff (Andrews, 2010).

In addition to functional specialization, other forms may be linked to experience, specialized knowledge, and professional training. Thus, the creation of teams dedicated exclusively to procurement and contracting activities contributes to building skills (Bonelli & Cabral, 2018). Specialization, for example, allows greater knowledge about the market (Porta et al., 2022) and how to specify and negotiate contracts (Cabral, 2017; Almeida & Sano, 2018), highlighting the role of people in procurement activity and hiring (Batista & Maldonado, 2008). Based on these arguments, we have the following hypothesis: "Higher levels of specialization in procurement are associated with higher performance" (H_3).

3. METHODOLOGICAL STRATEGY

This article adopted a quantitative approach whose objective was to identify how different dimensions of the organizational structure of the RFB procurement area relate to the performance of the function. The researched organization shows local units in each of the 27 federative units, as well as in 10 regional management and central units in the Federal District. The choice of the organization allows us to conjecture whether possible differences found in procurement performance would be related to the different structure dimensions of the area, given that all contracts were tendered by the same organization, which aids to reduce the possible effects of an analysis of multiple organizations with different demands and contracting capabilities (Cabral, 2017).

Each observation is a purchasing or contracting process, and the collected data includes information from a sample composed of 360 processes, selected via random sampling – with a 5% margin of error and a 95% confidence interval (Zα/2=1, 96) – considering a universe of 5,286 processes carried out during the analyzed period. The procurements that make up the sample were conducted via different contracting procedures, ranging from the public auction, which is the most formalized modality, to the supply of funds, which is a form of contracting that is not subordinated to the standard bidding process, as it is a less formal procedure, though it is still subject to rules.

The survey was conducted by extracting specific information from the efforts carried out and administrative processes in 2018 and 2019. The data sources were the computerized systems maintained by the RFB or other federal government organizations, including the Brazilian Integrated System of Financial Administration (SIAFI), the RFB Digital Process Management System (E-PROCESSO), the personnel management database, the Simples Nacional Portal, and the Federal Government Procurement Portal.

The justification for the time frame arises from the implementation of a process to expand the centralization of procurement, which, from 2012 to 2017 (MF Ordinance No. 203/2012), were often conducted by local units, a mostly decentralized model. This scenario was only changed with MF Ordinance No. 430/2017, which led to the restructuring of procurement processes and the feasibility of procedures with different levels of centralization, such as local, regional, and national purchases. This change promoted an environment conducive to exploring the different strategies adopted by the RFB in terms of centralization or decentralization of its procurement, given that this was the beginning of the adoption of a procurement regionalization strategy.

The absence of data for the period after 2019 is because collection was conducted from July to December 2022, when only data for the period from 2018 to 2021 were available. Due to the exceptional nature of the COVID-19 pandemic in 2020 and 2021 and due to its impacts on society, including internal public administration procedures, data from these years were not collected. Moreover, since all collection was conducted in 2022, it was not possible to obtain data from the subsequent period.

3.1 Performance variables in purchasing and contracting

This study employed four procurement performance variables, considering the difficulties inherent in the process of measuring performance in the area (Reis & Cabral, 2018; Rodrigues & Reis, 2023).

The first variable corresponds to the number of competitors who participated in the bidding, used as a proxy for performance. This premise is based on auction theory, which predicts a positive association between the number of competitors and auction revenue (Faria et. al., 2010). Competition is also recognized as one of the ways to address corruption in public procurement and contracting, as low competition rates can increase the amount of income that is illegally expropriated, as presented by Bajari et al. (2009) and Costa and Terra (2016, p. 93).

In the same direction, in normative terms, public procurement regulations have been strongly encouraged to promote competition between bidders (Reis & Cabral, 2018), as expressed in the principle of competitiveness present in the new bidding law (Law No. 14,133/2021). Table 1 suggests that, on average, each contract was competed for by five suppliers.

The second variable concerns the percentage variation in contracted prices compared to the reference price determined by the contracting body based on market price research. The results suggested an average reduction of 15% in contracted prices.

The third variable measures the bidding period, which represents the agility of the process, from the date on which the demand for acquisition was formally communicated and authorized by the procurement team until the date on which the contract was formalized, referring to the difference between the date on which the contracting process began and the date of completion of the purchasing. The results showed an average contracting period of 44 days. However, we highlight the heterogeneity of the performance variables, which can be observed based on the standard deviation values that are always higher than the averages.

The fourth variable measures the delay in delivery based on the difference in days between the date stipulated for procurement by the requesting unit via the Demand Formalization Document (DFD), available in only 135 observations, and the actual contracting by the procurement team. On average, deliveries were approximately seven days late. However, the high heterogeneity in contracting times draws attention, as in the extreme cases of deliveries made a year in advance or a year late.

TABLE 1 DESCRIPTIVE STATISTICS

Dimension	Parameter	Description	N	Mean	Standard deviation	Minimum	Maximum
Efficiency	Competition	Indicates the number of suppliers who participated in the contracting process.	360	5.76	8.56	1.00	65.00
	Price reduction (%)	Indicates the percentage variation of the value saved on the purchase in relation to the reference price charged: estimated by the formula ("Market Value" – "Contract Value") / "Market Value."	360	0.15	0.18	–0.94	0.83
	Bidding time (days)	Indicates the time (in days) it took for the purchase to be concluded: estimated by the formula "Contract Date" – "Order Date."	360	44.08	60.81	1.00	462.00
Efficacy	Delivery delay (days)	Indicates the period (in days) that the requesting unit was without the service after it became necessary: estimated by the formula ("Contracting date" – "Expected period").	135	6.99	74.77	–354.00	393.00
Centralization	Regionalization	Indicates the position in the hierarchical structure of the agency. Ordinal variable: 1 - purchases made by local teams (local units); 2 - purchases made by regional teams (middle managements); and 3 - purchases made by national teams (strategic apex).	360	1.28	0.52	1.00	3.00
	Aggregation	Indicates whether the purchase is carried out in a grouped manner in a hierarchically superior management unit. Dummy variable: 0 - Purchases demanded by the executing unit itself; and 1 - Purchases demanded by different units.	360	0.13	0.33	0.00	1.00
Formalization	Procedure	Indicates a proxy for the level of detail of existing rules to validate purchases. Ordinal variable: 1 – Corporate card (less formalization); 2 – Waiver of competitive bidding due to purchase value; 3 - Other waiver of competitive bidding and unenforceability of bidding; 4 - Electronic auctions (greater formalization).	360	2.28	0.79	1.00	4.00

Continue

Dimension	Parameter	Description	N	Mean	Standard deviation	Minimum	Maximum
Specialization	Occupational Specialization	Indicates the proportion of dedication of all members of the unit's team to the public purchasing activity. Ordinal variable: 1 - They also carry out people and technology management activities (Minor specialization); 2- Add activities in the logistics area such as contract and asset management and administrative support; and 3 - They only carry out procurement activities - acquisitions and hiring (Greater specialization).	360	2.05	0.64	1.00	3.00
	Buyer Experience (years)	Indicates the time (years) of professional experience in public procurement activities of the agent responsible for negotiating the purchase or contracting. If the agent has divided his time between tasks related to public procurement and other activities in each period, this will have a weight of 0.5.	360	4.26	3.39	0.00	19.88
	Training and academic formation	Indicates the level of training carried out by the agent responsible for negotiating the purchase or contracting. Discrete variable: one (1) point for each training course completed within three years before the procurement; one (1) point for each technical course completed; two (2) points for a graduation course related to public procurement activities; and three (3) points for a postgraduate course related to public procurement activities.	360	3.32	2.09	0.00	16.00

Continue

Dimension	Parameter	Description	N	Mean	Standard deviation	Minimum	Maximum
Controls: Contracting Characteristics	Asset specificity	It indicates the existence of investments in the transaction observed in such a way that there is a need for durability in the contract to guarantee an economic return for the supplier. Dummy: 0 - for the lack of need for specific durable investments by the supplier in support of the transaction; 1 - for the need for investments.	360	0.17	0.38	0.00	1.00
	Uncertainty	Indicates the successiveness of services and payments. Dummy: 0 - Immediate payment; and 1 - Continuous provision.	360	0.30	0.46	0.00	1.00
	Frequency	Indicates whether the contracted object was transacted in a previous process by the same responsible team. Dummy: 0 - New procurements; and 1 - Purchase of objects previously acquired by the executing team.	360	0.54	0.50	0.00	1.00
	Urgent Contracting	Indicates whether the procurement was anticipated and planned. Dummy variable: 0 – Budget planning initiatives; and 1 – Initiative carried out due to an unforeseen event.	360	0.40	0.49	0.00	1.00
	Supplier Size	Indicates the size of the supplier. Dummy variable: 0 – Other companies; and 1 - Company opting for the Simples Nacional Program, that is, Micro and Small Companies.	360	0.66	0.48	0.00	1.00
	Procurement Value (BRL)	Indicates the value (in thousands of reais) committed to the contract based on the information contained in the contract instrument, or in a substitute document.	360	46.02	165.00	0.02	1,614.70
	Procurement Month	Dummies that identify the month of procurement.	360	6.52	3.03	1.00	12.00

Source: Research data.

3.2 Explanatory variables: purchasing and contracting structure

This study considered three groups of independent variables, namely centralization (H_1), formalization (H_2), and specialization (H_3). This aimed to verify the hypotheses about the expected associations between dimensions of the organizational structure of the procurement area and performance.

The H_1 group includes two variables that identify the centralization of the procurement structure in terms of regionalization and aggregation of demands. The first is an ordinal variable that takes on a value equal to 1 for purchases performed by local units (76% of the 360 observations in the core operations), 2 for regional purchases (20% in the average line), and 3 for those performed by the central unit (4% at the strategic peak). In other words, local purchases correspond to the highest level of decentralization and are the predominant form of contracting, whereas those carried out by the central unit represent the smallest volume.

The second dichotomous variable considers a value equal to 1 for purchases demanded by subordinate units, made in a grouped manner in a hierarchically superior management unit, and zero for purchases made by the unit responsible for the demand itself. Thus, it is a variable that measures the centralization or decentralization of processes in terms of aggregation of demand from various RFB units, with 13% of the cases analyzed representing aggregation of demand. On average, the values of aggregate purchases correspond to five times the value of those made in a decentralized manner by the units themselves.

The second group includes only one explanatory variable as a proxy for process formalization. Despite being an important measure for control and transparency in the public sector, the formalization provided for in Brazilian legislation includes a diversity of procurement procedures, which, notably, impose greater or lesser freedom of choice in the process. Therefore, it is an ordinal variable that identifies the different procedures to be followed, starting from the least formal level, from the perspective of the buyer's freedom of choice, to the most formal.

The least formalized procurements are those made through the supply of funds, which assumes a value equal to 1, as it is a procedure that must be adopted for purchases that cannot be carried out following the normal expenditure cycle (direct contracting or bidding). This procedure was adopted in 7.2% of observations. Next, there are direct contracts such as waiver of competitive bidding due to purchase value, which assume a value equal to 2 and represent 71.4% of the sample. The other waiver of competitive bidding and unenforceability of biddings, all direct contracts, have a value equal to 3 and correspond to 7.5% of the sample. Finally, the most formal procedure consists of purchase via the auction modality, in electronic form, which assumes a value equal to 4 and corresponds to 13.9%.

On the one hand, such results corroborate the statement provided by the legislation, that is, bides are less practiced, in terms of number of processes, than direct purchases. On the other hand, it is important to highlight that the financial resources contracted without bidding correspond, on average, to 11,300 BRL per contract, compared to 261,300 BRL per electronic auction. Of the amount of 16,500,000 BRL spent on the 360 contracts, 79% were via bidding.

The third group includes three variables related to the procurement specialization dimension, considering occupational specialization, professional experience, and academic education and training.

The variable "occupational specialization" is measured inversely to the number of tasks and work processes assigned to that team or department. This is an ordinal variable that takes on a value of 3 for teams with a higher level of dedication to procurement activities, exclusively performing such

activities. These teams correspond to 23.1% of cases and are called bidding sections (SALIC). Teams that, in addition to procurement activities, perform other tasks in supply management, such as contract administration, asset and patrimony management, and administrative support, have a value equal to 2 and are responsible for most of the procurements analyzed (58.6%), called logistics sections (SEPOL). The less specialized teams, which carry out, in addition to SEPOL's activities, other administrative tasks, such as personnel and technology management, receive a value of 1 and represent 18.3% of the observations, being designated as corporate management sections (SECOR).

The variable "professional experience" identifies the number of years of work in procurement activities of the agent responsible for negotiating the purchase since joining the researched organization (average of 4.26 years). If the agent has divided their time between tasks related to public procurement and other activities in each period, it will count with a weight of 0.5.

The variable "academic education or training" quantifies, in a discrete way, the level of training and education of the person responsible for public procurement based on the sum of the following scores: one point for each training course completed in the period of up to three years before the purchase, one point for each technical course completed, two points for a graduation course related to the procurement activity, and three points for a postgraduate course related to the activity. With an average of 3.3 points and 91.5% of employees with a score above zero, that is, with at least one training or course in the area, the results suggest that the organization chosen for analysis has an active training and qualification of procurement professionals.

3.3 Control variables

In addition to the variables linked to the procurement structure, a set of controls endorsed by previous studies were adopted. In total, three variables related to the transaction cost theory were used (Faria et al., 2010), which measure transactional attributes related to asset specificity, uncertainty, and frequency, via dichotomous measures that take on a value equal to 1, when such attributes are present in the contracting process, and zero otherwise. The size of the contracted company (Reis & Cabral, 2015) assumes a value equal to 1, if that supplier is a micro or small entrepreneur, and zero otherwise.

The characteristics of the procurement process also refer to its urgency, being equal to 1 for urgent contracts and zero otherwise, and the number of resources, in Brazilian reais, involved in the deal (Bonelli & Cabral, 2019). Finally, dummy variables were used to identify the month in which the contract was carried out.

3.4 Data analysis techniques

Considering the characteristics of the performance variables, the relationships between the different dimensions of the structure were assessed using ordinary least squares (OLS) models for performance variables of a discrete or continuous nature, including number of competitors, percentage reduction in contracted prices, contracting period (days), and delivery delay (days). The Stata software (version 14) was used to estimate the models. Such models have been widely used in studies on public procurement performance in Brazil (Cabral et al., 2015, Faria et al., 2010; Gonçalves & Figueiredo, 2023) and internationally (Petersen et al., 2022).

Table 2 presents the results of the statistical analysis to verify the association between procurement structure and performance. In total, eight models (M1 to M8) of OLS regressions were estimated, two for each of the dependent variables. The first model for each dependent variable includes only variables related to the structure of the procurement area, that is, independent of the study. The second model, in addition to the structural variables, incorporates control variables, that is, the contracting characteristics that can influence the outcome of the bidding, even though they are not the subject of discussion in the hypotheses presented in the theoretical framework.

4. RESULTS AND DISCUSSION

Table 2 data demonstrate that, in all models, at least one structure variable demonstrated a statistically significant association with the performance variables.

For the centralization dimension (H_1), in the context of the RFB, aggregate procurement are associated with greater delivery delays (M7 and M8). This finding corroborates the argument that, in decentralized units, knowledge about specific demands is present more naturally, and, thus, solutions tend to be faster (Petersen et al., 2022). Today, the value of time and the need to minimize waste in the supply chain have increased importance as a key variable in public procurement (Baily et al., 2015).

On the other hand, aggregate procurement did not show a significant association with contracting performance in terms of competition (M1 and M2), price reduction (M3 and M4), and contracting times (M5 and M6), corroborating the contradictory results of studies such as Petersen et al. (2022), which demonstrated the positive effect of centralization on price increases, and those of Karjalainen (2011) and Patrucco et al. (2020), who demonstrated a positive association between a higher level of centralization and price discounts. Specifically, regarding the RFB, we found no impact of economies of scale, suggested in the theory on which these and other studies are supported (Glas et al., 2017; Porta et al., 2022) and which are part of the very motivation for implementing the new model.

From a hierarchical level perspective, purchases performed by central teams (M5 and M6) are associated with longer contracting times. This result is consistent with the literature and partially corroborates the hypothesis since, as pointed out by Almeida and Sano (2018, p. 100), the lack of greater integration between sectors – demanding and executing the contract – can increase the contract period. Therefore, as centralization can increase the need for integration between departments, it is reasonable to assume that the centralized model requires more time for each deal. On the other hand, it must also reduce the number of processes.

The results, however, do not allow us to state that the decentralized model is necessarily the most appropriate, as the strategy for developing the function must include several aspects, which, in turn, are related in a complex way to the multiple possible performance measures in public procurements, many of which are beyond the scope of this research. On the subject, we highlight the views of Andrews (2010), Baily et al. (2015), and Porta et al. (2022), who converge on the conclusion that a mixed model of centralization and decentralization might improve the performance of the procurement function.

It should be considered that the results point to a possible trade-off between time and financial resources, which influences the definition of objectives and the organizational structure. The study partially ratifies H_1 by demonstrating positive effects between procurement aggregation and delay, as well as between its centralization and contracting time. In turn, the elements of the hypothesis that focused on the association with aspects related to financial resources were not proven, perhaps due to the need for greater maturation of the regionalization and aggregation model, as the measurements were made shortly after the publication of the ordinance.

TABLE 2 REGRESSIONS ASSOCIATION BETWEEN PURCHASING STRUCTURE AND PERFORMANCE

Parameter		Competition		Price reduction		Bidding time		Delivery Delay	
		M1	M2	M3	M4	M5	M6	M7	M8
Centralization	Aggregation	–0.0597	–0.0917	–0.0112	–0.00886	9.243	4.020	65.35 ***	55.75**
		(1.448)	(1.444)	(0.0364)	(0.0371)	(9.886)	(9.894)	(22.28)	(24.41)
	Central purchases	–0.934	–1.302	–0.0427	–0.0443	36.37*	45.31**	–50.13	–56.80
		(3.026)	(2.957)	(0.0761)	(0.0760)	(20.66)	(20.26)	(47.45)	(49.78)
	Regional purchases	0.569	0.563	0.0571	0.0483	11.26	14.18	–20.69	–49.81
		(2.552)	(2.479)	(0.0642)	(0.0638)	(17.42)	(16.98)	(43.55)	(47.48)
		Base line: local purchases							
Formalization	Electronic auctions	16.21 ***	12.97 ***	0.161 ***	0.0593	123.9 ***	132.2 ***	39.17 ***	96.24 ***
		(1.802)	(2.171)	(0.0453)	(0.0587)	(12.30)	(15.65)	(14.81)	(23.15)
	Waiver of competitive bidding due to purchase value	3.145**	3.115**	0.167 ***	0.125***	25.19**	25.06**	–	–
		(1.507)	(1.579)	(0.0379)	(0.0408)	(10.29)	(10.88)	–	–
	Other waiver of competitive bidding and unenforceability of bidding	1.357	–0.213	0.103**	0.0858	40.31***	39.37***	22.74	36.18*
		(2.008)	(2.090)	(0.0505)	(0.0537)	(13.71)	(14.31)	(19.24)	(20.80)
		Base line: Corporate card							
Specialization	Superior specialization	–2.997	–2.983	–0.0347	–0.0135	3.726	–0.918	37.00	55.69
		(2.692)	(2.623)	(0.0677)	(0.0676)	(18.38)	(18.00)	(45.21)	(48.71)
	Partial Specialization	–2.513**	–2.337**	0.00892	0.0211	9.926	8.461	20.61	12.48
		(1.013)	(0.991)	(0.0255)	(0.0257)	(6.913)	(6.847)	(16.59)	(17.60)
	Agent experience (years)	0.166	0.207*	0.00564*	0.00413	–1.759**	–1.860**	–2.483	–1.680
		(0.120)	(0.119)	(0.00303)	(0.00307)	(0.822)	(0.817)	(1.969)	(2.021)
	Training and academic formation	0.121	0.197	0.00727	0.00620	–0.895	–1.200	–1.587	–3.031
		(0.191)	(0.186)	(0.00480)	(0.00479)	(1.303)	(1.277)	(3.690)	(3.816)

Continue

Parameter		Competition		Price reduction		Bidding time		Delivery Delay	
		M1	M2	M3	M4	M5	M6	M7	M8
Controls: contracting characteristics	Competition (number of suppliers)				0.00373***		–1.060***		–1.624**
					(0.00141)		(0.376)		(0.726)
	Supplier size		–0.308		0.0102		2.129		0.230
			(0.797)		(0.0205)		(5.461)		(13.85)
	Contracting Value		7.88e–06***		–3.26e–08		8.51e–06		2.43e–05
			(2.82e–06)		(7.32e–08)		(1.95e–05)		(3.93e–05)
	Urgent contracting		–0.180		–0.0588**		–5.202		12.09
			(0.907)		(0.0233)		(6.211)		(16.48)
	Assets specificity		5.039***		0.0399		–11.23		–30.68
			(1.462)		(0.0383)		(10.19)		(21.96)
	Uncertainty		–3.107***		0.00282		27.19***		8.905
			(1.188)		(0.0309)		(8.219)		(22.42)
	Frequency		0.577		–0.0585***		–23.96***		–34.26**
			(0.843)		(0.0217)		(5.777)		(16.34)
	Dummies for contracting month		Sim		Sim		Sim		Sim
			(2.214)		(0.0569)		(15.16)		(34.69)
	Constant	2.143	–0.174	–0.0572	–0.00101	4.895	30.10	–13.63	28.83
		(1.879)	(2.862)	(0.0473)	(0.0736)	(12.83)	(19.60)	(20.75)	(39.66)
	Observations	360	360	360	360	360	360	135	135
	R2	0.331	0.416	0.078	0.162	0.382	0.459	0.158	0.310

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Source: Research data.

For H_2, which deals with formalization, we found that all dependent variables showed a statistically significant association with at least one of the formality levels of the contracting procedure. This, on the one hand, indicates that formalization moves in the same direction as increasing the number of participants in the bidding and reducing the price, which contributes to competition and savings to the treasury. On the other hand, the positive sign for bidding time confirms that more formal procedures are associated with less speed in the contracting process, presenting similarities with studies in the area that attribute performance problems in public organizations to bureaucratic dysfunctions (Almeida & Sano, 2018; Andrews, 2010; Baily et al., 2015; Petersen et al., 2022) caused by the rules required by legislation.

As for the "delay" variable, the results indicate a positive association with auction and a negative association with the waiver of competitive bidding due to procurement value modality. This finding suggests that greater flexibility in choosing a supplier in the dispensation process tends to contribute to reducing problems with delivery delays.

Once again, the opposition between time and price suggested by the results creates a dilemma that can be explored by the organization according to its strategic interests, especially because it is possible to reduce bottlenecks related to the performance of the procurement function. This can mitigate any possible negative effects related to the adoption of electronic bidding on contracting time and delivery delays compared to less formalized modalities. Thus, we found another potential trade-off situation between price reduction and time, which presupposes the adoption of a mixed procurement model.

It should be noted, however, that the "auction" modality itself was an innovation in the scope of Brazilian public procurement, adopted to mitigate the issues associated with formalism and due to being recognized for the gains in terms of efficiency and speed. Moreover, the formalization of procurement processes is strongly influenced by the assumption that, without appropriate controls, employees naturally gravitate towards maximizing utility on their own terms (Andrews, 2010, our translation, p. 96).

In addition to the number of rules in each procedure, formalization could be better investigated by measuring other variables, such as quantities of normative acts – normative instructions, ordinances, enforcement rules, etc. – or performance control routines and systems, which could not be measured in the present research because there was no intra-organizational variability.

Based on the above, hypothesis H_2 partially corroborated the association between formalization and the variables that deal with the speed of the bidding process and delay in contracting; however, the results related to competition and the economy do not support the study hypothesis. Therefore, the findings suggest that the formalization of the procurement structure is associated with mixed results in the different dimensions of function performance.

About H_3, which deals with specialization, the two significant relationships found are of special interest for the study conclusions – one of them due to its counterintuitive aspect.

Regarding occupational specialization, the results showed a negative association between teams with an intermediate position in terms of occupational specialization and the number of competitors. It is reasonable to assume that this result can be explained by the fact that these teams plan purchases more carefully, precisely because they carry out more tasks and serve units with a smaller structure.

In many cases, the administrative cost of including work processes, such as the use of corporate cards, is prohibitive. Therefore, units must include their demands in previously scheduled auctions or be left without the fund due to the rigidity of the structure. Specifically, at RFB, this low flexibility is

manifested by little coordination between units, especially between procurement teams. Paradoxically, units with lower operational capacity require more rigid planning. As a result, teams with less capacity to convert investment into formal procedures (such as electronic auctions) to achieve economies of scale via competition are the ones that least use tools (such as fund supplies) for strategic gains in agility and flexibility (Bonelli & Cabral, 2018; Dimitri et al., 2006; Porta et al., 2022).

The variable that measures specialization based on professional experience showed a significant association with the reduction of the bidding period. It can be admitted that the knowledge built and acquired over years of practice enables buyers to better manage the time used to purchase, ensuring the speed of contracting and the satisfaction of the organization's demands in a timely manner, reinforcing the findings of Reis et al. (2023) and expanding studies such as those by Gonçalves and Figueiredo (2023).

Thus, the results presented partially support H_3, as only the "professional experience" dimension was associated with positive performance over time, while occupational specialization was negatively associated with competition, partially confirming the hypothesis.

5. CONCLUSIONS

Whether due to the size of the Brazilian public administration, which demands a large volume of purchases, or due to the peculiarities of the established standards, there is an urgency to improve the performance of the procurement function of various agencies. This study generates value by relating dimensions of the organizational structure of procurement to the performance of this function. Thus, identifying the associations between dimensions of the structure of the RFB's procurement function and its performance indicators was the main contribution, aiming to meet the demand present in the literature for studies that investigate this relationship.

The article reveals that the organization can explore a trade-off between performance variables related to financial resources (price reduction and competition) and time (contracting speed and delivery delay) based on adjustments in its organizational structure or the alignment of the procurement strategy with the existing structure.

For example, it would be possible, based on new models of regionalization and, why not, centralization, to establish more specialized teams in purchasing inputs with the strategic possibility of reducing prices and administrative costs via competition and aggregation of similar procurements. These teams could count on buyers who are experienced and qualified to conduct this type of contracting, which, based on the results presented, suggests the execution of electronic auctions and unenforceability of biddings.

On the other hand, the structure could also include more decentralized and flexible teams, although procurement time might be more beneficial, especially in contracts governed by market equilibrium or the most urgent ones.

These movements could improve relationships with key suppliers, resulting in savings in procurement and an advantage in more stable and less asymmetrical relationships between the organization and its suppliers.

Regarding the limitations observed in this study, we highlight that the number of dimensions and variables available was insufficient to capture all the nuances of the observed phenomena, which may imply biases in the results obtained, such as the impact of the purchase price or the contracted

object on the procedure, or even the financial importance of strategic contracts such as the provision of information technology services (SERPRO and DATAPREV).

Moreover, dimensions such as effectiveness could not be measured and included in the models. In the same direction, a limitation worth mentioning is the fact that the universe studied is limited to procurements at RFB in a time frame encompassing the beginning of the procurement regionalization process and the date of data collection. Thus, even though our results are comparable with those eventually obtained in other studies, it is not possible to generalize our conclusions to other government entities. We also highlight that the sample value was affected by the number of procurement processes carried out in the defined period.

Finally, as a suggestion for future research, qualitative studies are recommended with the aim of understanding the phenomena studied from the perception of different stakeholders in the procurement process, such as managers, buying agents, demanders, suppliers, and service users. Comparative studies are also suggested, focusing on other public organizations or the RFB itself, if a different structural arrangement is implemented for its procurement function.

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DATA AVAILABILITY

The entire dataset supporting the results of this study is available upon request to the corresponding author Arthur Vinicius da Costa Ferreira Pinto. The dataset is not publicly available due to it is information obtained through a formal request from the Federal Revenue of Brazil, requiring formal authorization to transfer data.

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