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Regulatory Thresholds and Procurement Costs: Evidence from Induced Distortions

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Eliana Álvarez, Rodrigo Ceni, Federico Scalese y Román Sugo*

Resumen

Los gobiernos asignan recursos sustanciales a través de las compras públicas, pero el diseño de las regulaciones de contratación implica una disyuntiva entre la transparencia y los costos que estas imponen a los organismos contratantes. Comprender cómo estas normas afectan el comportamiento de compra y los costos de adquisición es fundamental para diseñar políticas eficaces. En este trabajo estudiamos cómo los umbrales regulatorios de contratación pública influyen en las decisiones de compra y cuáles son sus implicancias en términos de costos para los organismos contratantes en un país de ingreso medio. Utilizando una base de datos administrativa exhaustiva que cubre todas las compras públicas realizadas en Uruguay entre 2002 y 2021, explotamos un umbral regulatorio que determina el procedimiento de contratación aplicable. Este umbral genera discontinuidades en los requisitos de contratación, ya que los procedimientos más transparentes implican mayores cargas administrativas. Mostramos que los umbrales de contratación inducen distorsiones significativas en el comportamiento de compra: aproximadamente el 7,5 % de las adquisiciones se concentra justo por debajo del umbral. Estas respuestas son inmediatas y asimétricas frente a cambios regulatorios: la flexibilización de los umbrales reduce las distorsiones, mientras que su endurecimiento incrementa su prevalencia. Las distorsiones son más pronunciadas al final del año fiscal, entre los organismos sujetos a una regulación más estricta y en entornos con menor intensidad de auditoría. Asimismo, la existencia de relaciones repetidas con proveedores aumenta la probabilidad de que ocurran estas conductas. De manera importante, estas distorsiones tienen implicancias medibles sobre los costos. Las compras afectadas se asocian con precios más altos y con una mayor probabilidad de sobreprecio. Finalmente, estimamos que el costo implícito de utilizar un procedimiento más exigente equivale aproximadamente a 1,5 veces el monto adjudicado en el umbral de contratación. Estos resultados aportan evidencia relevante para el diseño de políticas públicas orientadas a equilibrar los beneficios de la transparencia con los costos asociados a su implementación.

Palabras clave

Compras públicas; costos de contratación pública; umbrales regulatorios; distorsiones de comportamiento; transparencia.

Clasificación JEL

H57, D73, D47

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Abstract

Governments allocate substantial resources through public procurement, yet the design of procurement regulations involves a trade-off between transparency and the costs they impose on contracting authorities. Understanding how these rules affect purchasing behavior and procurement costs is essential for effective policy design. In this paper, we study how procurement thresholds shape purchasing decisions and their cost implications for contracting authorities in a middle-income country. Using a comprehensive administrative dataset covering all public procurement in Uruguay between 2002 and 2021, we exploit a regulatory threshold that determines the procurement procedure. This threshold creates discontinuities in procurement requirements, as more transparent procedures involve higher administrative burdens. We show that procurement thresholds induce significant behavioral distortions, with approximately 7.5\% of purchases clustering just below the cutoff. These responses are immediate and asymmetric to regulatory changes: relaxing thresholds reduces distortions, while tightening them increases their prevalence. Distortions are more pronounced at the end of the fiscal year, among more regulated buyers, and in environments with lower auditing intensity. Repeated relationships with suppliers also increase their likelihood. Importantly, these distortions have measurable cost implications. Affected purchases are associated with higher prices and a greater probability of overpricing. Finally, we estimate that the implicit cost of using a more stringent procedure is equivalent to approximately 1.5 times the procurement award at the threshold. These findings provides evidence on balancing transparency and cost.

Keywords

public procurement; procurement costs; regulatory thresholds; behavioral distortions; transparency

JEL Classification

H57, D73, D47

1 Introduction

Governments worldwide engage in a wide range of activities to ensure compliance with the law and to provide public goods and services. To fulfill these roles, governments allocate a substantial share of resources to public procurement, representing approximately 12% of global GDP (Bosio et al., 2022; OECD, 2021; Coviello and Mariniello, 2014). While this level of spending plays a key role in stimulating economic activity, it also raises important challenges related to efficiency, transparency, and the design of procurement systems (Bandiera et al., 2021; Carril, 2021; Palguta and Pertold, 2017; Coviello and Gagliarducci, 2017; Ferraz et al., 2015). In particular, procurement regulations aim to balance the benefits of transparency and competition against the administrative and operational costs they impose on contracting authorities. However, the extent to which these rules affect purchasing behavior and overall procurement costs remains an open empirical question (Coviello et al., 2022; Palguta and Pertold, 2017; Decarolis et al., 2016; Bandiera et al., 2009).

In this paper, we study how procurement regulations shape purchasing decisions and generate cost implications for contracting authorities through both administrative burdens and behavioral distortions. Specifically, we focus on monetary thresholds that determine the procurement procedure to be used. These thresholds create discontinuities in the costs of procurement, as more stringent and transparent procedures typically involve higher administrative burdens and longer processing times. As a result, procurement officers may adjust their purchasing behavior to avoid crossing these thresholds, generating distortions in procurement decisions. These distortions suggest that procurement decisions are not solely driven by efficiency considerations, but also by the costs of complying with regulatory requirements. We examine how these behavioral responses affect both the allocation of purchases and the costs faced by the public sector.

To do so, we construct a comprehensive administrative database covering all public procurement of goods and services carried out by government offices in Uruguay between 2002 and 2021. The institutional setting provides a particularly suitable context for our analysis, as procurement procedures differ markedly in terms of transparency requirements and bureaucratic burden. We exploit a regulatory threshold that separates a simplified procedure, *direct procurement*, from a more transparent and demanding one, the *shortened auction*. In addition, we leverage two large and plausibly exogenous changes in this threshold: a substantial increase in 2012 and a sharp reduction in 2020. These policy changes allow us to study how procurement officers adjust their behavior when the cost of complying with more stringent procedures varies.

Our empirical approach builds on the bunching framework developed by Slemrod (2010); Kleven (2016); Kleven and Waseem (2013), which exploits discontinuities in policy rules to detect behavioral responses. In this context, thresholds generate incentives for purchases to cluster just below the cutoff, reflecting attempts to avoid more burdensome procedures (Bertanha et al., 2022). We extend this approach by combining it with a difference-in-differences strategy to analyze how these distortions respond to both increases and decreases in regulatory stringency. This allows us to characterize not only the existence of behavioral distortions, but also their asymmetry when procurement rules become more or less demanding.

Firstly, we analyze whether public buyers adjust procurement decisions to avoid the costs associated with complying with more stringent and transparent procedures. Such responses may involve modifying

contract values, splitting purchases into smaller components, or selecting less demanding procurement mechanisms. While the literature often interprets these behaviors as distortion, particularly in contexts such as construction or emergency procurement, we interpret them more broadly as behavioral responses to regulatory design (Bandiera et al., 2021). These responses reflect an underlying trade-off between the benefits of transparency and the costs imposed by more complex procedures. For instance, greater discretion may allow buyers to respond more quickly or efficiently in certain contexts, but at the expense of reduced transparency and competition. Prior work shows that such responses can lead to higher prices, changes in timing, and allocation toward more connected firms (Coviello et al., 2021; Baltrunaite et al., 2021; Baranek and Titi, 2021; Gallego et al., 2020). In addition, policies aimed at strengthening oversight, such as auditing, may unintentionally increase these behavioral responses by raising the relative cost of more transparent procedures (Gerardino et al., 2017).

Secondly, we analyze how public buyers react to changes in procurement thresholds, exploiting two large reforms, one that relaxed the rules and another that made them more stringent, to assess the asymmetry in these responses. Combining a bunching framework with a difference-in-differences strategy, following Carril (2021), we estimate how changes in regulatory stringency affect purchasing behavior around the threshold. While previous work has focused on the effects of relaxing procurement rules, we extend the analysis by examining both directions of policy change. This allows us to characterize how distortions in procurement decisions evolve when the cost of complying with more transparent procedures increases or decreases, and to quantify the resulting adjustments on both the intensive and extensive margins.

Thirdly, we assess the characteristics and mechanisms underlying these behavioral distortions. Existing evidence suggests that institutional context plays a key role in shaping procurement outcomes (Coviello et al., 2022), with factors such as the type of goods, organizational structure, and bureaucratic incentives affecting performance (Bandiera et al., 2009; Best et al., 2023; Bucciol et al., 2020). We examine how these distortions vary across time, particularly over the fiscal year, as well as across different types of contracting authorities and levels of auditing intensity. In addition, we analyze the role of repeated interactions with suppliers, showing how prior relationships can increase the likelihood of distorted procurement decisions. Finally, we link these mechanisms to procurement outcomes, showing that purchases affected by these distortions are associated with higher prices and a greater probability of being overpriced.

The model builds on Carril (2021) and captures the trade-off between increased transparency and the administrative and operational costs imposed by more demanding procurement rules. Using the observed behavioral responses around the threshold, we infer the level of procedural cost that is consistent with the data and quantify how it shapes procurement decisions.

Finally, we develop a simple model to interpret the behavioral responses around procurement thresholds and recover the implicit cost of complying with more stringent procedures. The model builds on Carril (2021) and captures the trade-off between increased transparency and the administrative and operational costs imposed by more demanding procurement rules. In particular, when procurement values exceed a regulatory threshold, buyers incur additional administrative and procedural costs required to implement more transparent mechanisms. Using the observed behavioral responses around the threshold, we infer the level of procedural cost that is consistent with the data and quantify how it shapes procurement decisions. This approach allows us to provide evidence on the trade-off between transparency and

cost in public procurement systems.

Our main findings show that procurement thresholds generate significant behavioral distortions, with approximately 10% of purchases clustering below the cutoff. These distortions respond strongly and asymmetrically to changes in regulation: relaxing thresholds reduces distortions, while tightening them increases their prevalence. We also find that these effects are more pronounced at the end of the fiscal year, among more regulated contracting authorities, and in environments with lower auditing intensity. Importantly, we show that these distortions have measurable cost implications, leading to higher procurement costs and potentially less efficient allocation of public resources.

This paper contributes to the literature in three main ways. First, it provides new evidence on how procurement regulations shape purchasing behavior and generate cost implications for contracting authorities through behavioral distortions and administrative burdens in a middle-income country context. While most existing evidence comes from developed countries, our results highlight the relevance of these mechanisms in settings where procurement systems are still evolving. Second, we document a set of institutional and behavioral determinants of procurement distortions, including auditing intensity, organizational characteristics, and repeated interactions with suppliers, and document their association with higher procurement costs. Third, we quantify the trade-off between transparency and administrative costs, providing novel evidence on the magnitude of the burden imposed by more stringent procurement procedures.

These findings have direct implications for the design of procurement systems. While more transparent procedures are essential to ensure accountability and competition, they also impose non-negligible costs on contracting authorities. Understanding this trade-off is crucial for designing procurement rules that enhance transparency without generating excessive distortions or inefficiencies in public spending.

The remainder of the paper is organized as follows. Section 2 describes the institutional setting and procurement procedures. Section 3 presents the data and main variables. Section 4 outlines the empirical strategy used to identify behavioral distortions. Section 5 examines their determinants and consequences. Section 6 introduces the model used to quantify procedural costs. Finally, Section 7 concludes.

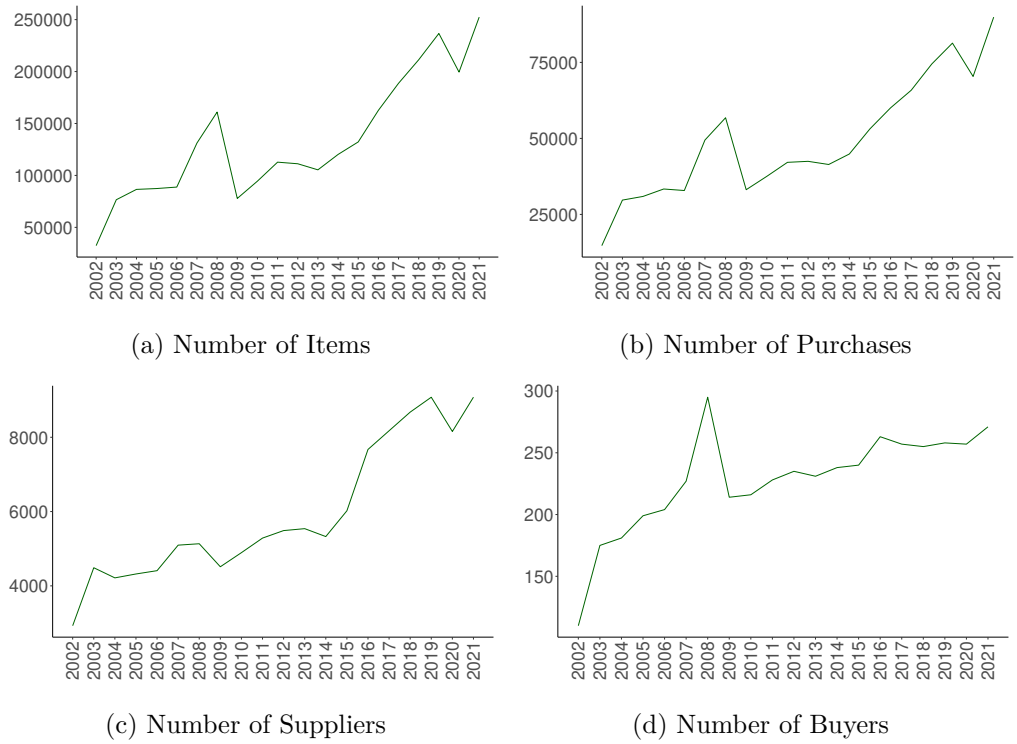
2 Background

Uruguay's public procurement regulation is supervised by the *Agencia Reguladora de Compras Estatales* (ARCE by its acronym in Spanish). ARCE is a technically autonomous institution that reports to the President's office. It is responsible, among other tasks, for advising public institutions and suppliers in procurement procedures and best practices, promoting public policies for transparency in public procurement, and publicizing contract opportunities electronically. These regulatory efforts aim to enhance transparency and competition, but they also introduce administrative and operational costs for contracting authorities.

As in many developing countries, the Uruguayan open and electronic procurement system has a recent history. In the late nineties and the early 2000s, public procurement began to be regulated centrally through supplier and procurement records. Initially, only some offices within the public administration registered their procurements, with the requirement being compulsory only for Public Auctions.[1] In 2011,

[1]The regulations are the Presidential Acts N 342/99 and 289/002.

Figure 1: Take up of the ARCE database



(a) Number of Items

(b) Number of Purchases

(c) Number of Suppliers

(d) Number of Buyers

Note: Source*Agencia Reguladora de Compras Estatales* (ARCE by its acronym in Spanish). The four panels of the figure show the Open Contracting Standard take-up in our setting between 2002-2022. We consider in the up-lefter panel the number of items registered, in the up-right panel the number of procurement, in the down-left the number of public buyers and in the down-right the number of suppliers.

it became mandatory to publicize the opening, closure, and cancellation of all competitive procedures (auctions) on ARCE's website.[2] Later on, this included new procedures such as Direct Procurement.

Beyond regulation, public offices embraced digital tools at different speeds. In general, public procurement records of all public sector entities - at the national and sub-national levels - have extended over the years, mainly up to 2018, as shown in Figure 1. This figure plots the evolution of the existing records in our database in terms of items acquired, number of purchases, suppliers, and buyers. Notably, there is an increasing trend in all four dimensions. By the end of the period, there are around 80 thousand purchases yearly involving 250 thousand items, 9,000 suppliers, and approximately 300 public buyers.

The three most used public procurement procedures stated in Uruguayan law are: *Direct Procurement*, *Shortened Auction*, and *Open Auction*. For all of them, the supplier must be registered in the administrative records and comply with their taxes and contributions. Both *Direct Procurement* and *Shortened Auction* have a maximum amount threshold to carry them out. The *Direct Procurement* is the simplest mechanism available to the public buyer. They must publish on a website for at least 48 hours, and there is no minimum number of suppliers, although three suppliers are recommended for best practice reasons. The *Shortened Auction* must be open for between five and ten days and invite at least three suppliers. Finally, the *Open Auction* must be open for at least 15 days, with a higher bureaucratic burden than the others. In July 2020, the government introduced a new procurement format, the *Price*

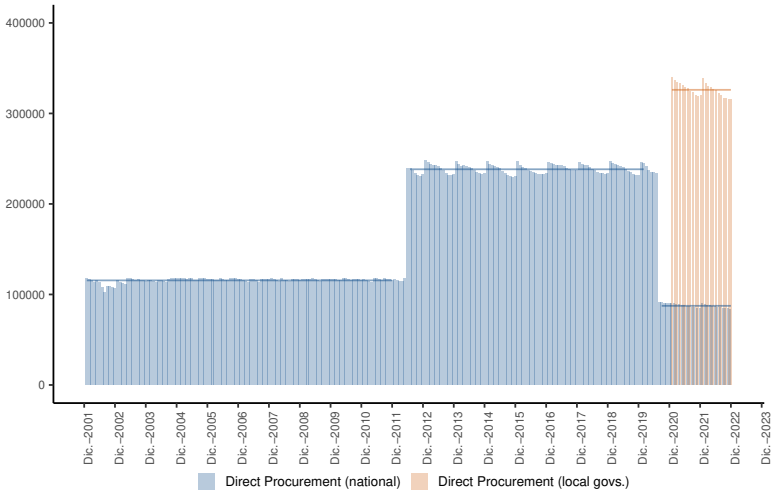
[2]The regulation is the Art. 50 TOCAF (Texto Ordenado Contabilidad y Administración Financiera) and Presidential Act 277/13.

Contest, in which the buyer discretionarily invites at least three suppliers to participate within a period of three days.[3] These procedures differ not only in their level of transparency and competition, but also in the administrative burden and costs they impose on contracting authorities.

2.1 Threshold Changes

In Figure 2, we show the evolution of the monetary thresholds established to qualify for *Direct Procurement*, *Shortened Auction*, and *Price Contest* in the last twelve years. The *Direct Procurement* threshold remained practically constant between January 2002 and May 2012 at around $U 115,000 Uruguayan pesos (prices of October 2010).[4] The first major change was in June 2012, when this threshold was doubled to $U 240,000 and remained at that value until June 2020 when it was established at $90,000.[5] The Presidential Acts establishing these thresholds were implemented without previous announcement or specific arguments, so they can be plausibly considered exogenous from the perspective of public buyers. The *Shortened Auction* threshold was around $2,300,000 between January 2002 and May 2012, when it was raised to $4,700,000 and remained at this value until July 2020, when it slightly decreased to around $4,300,000. Finally, in July 2020, the government established a new procedure, *Price Contest*, with a threshold of $440,000.[6] These threshold changes generate discrete variation in the cost of procurement procedures, providing a suitable setting to study how regulatory design affects purchasing behavior and procurement costs.

Figure 2: Direct procurement thresholds 2002-2021



Note: Source: TOCAF. The lines represent averages in constant Uruguayan pesos as of December 2010. The blue line represents the threshold for using the *Direct Purchase* procedure, and the orange line indicates the threshold for local government procurement

[3] In both panels of Figure B.1 we show the shares of procurement procedures by quantity and amount. There is a great majority of Direct Procurement during the whole period, around 70%, but it represents less than 10% of the total spending. Public auctions in quantity are less than 10% but represent more than 50% of the total spending.

[4] The government adjusts the amount yearly by the inflation rate.

[5] In June 2020, the government established two thresholds for the *Direct Procurement*, one at $90,000 for almost all public buyers, and another at $325,000 only for local governments.

[6] All prices here are in Uruguayan pesos as of October 2010.

3 Data

Our main source of information is Uruguay's public procurement records, available on ARCE's website. This agency publishes daily information about acquisitions by national and sub-national offices, following the Open Contracting Data Standard (OCDS).[7] Since 2017, they have also adapted records from 2002-2016 to the OCDS data structure. The datasets include variables such as buyer, supplier, item(s) acquired, quantities, prices, total amount, currency, and acquisition date, among others (more details on the data cleaning process are provided in Appendix A).

Although these records provide detailed information on procurement transactions, they do not include unit prices. Unit prices are crucial for our analysis, as they allow us to compare the costs paid by different institutions for identical or highly comparable products. To construct unit prices, we require detailed product-level information (e.g., brand, presentation, and other characteristics). This information is available on ARCE's website but not included in the OCDS datasets. Therefore, we collect it through web scraping and merge it with the administrative records. In total, we incorporate detailed information for 39,170 products.

As mentioned, the use of the platform and the completeness of reporting vary across public offices. To improve data consistency and comparability, we restrict the analysis to records from national-level offices between 2002 and 2021. This results in a sample of more than 900,000 procurement transactions (see Table B.1 in Appendix B).

We further enrich the procurement records by integrating data from additional sources. In particular, the *Tribunal de Cuentas* serves as the supreme audit institution, operating with technical, organic, and functional autonomy to oversee the management of the Public Treasury. Its role includes monitoring procurement practices and identifying deviations from established procedures, although it does not have enforcement power. We compile a comprehensive dataset of all observations made by the *Tribunal de Cuentas* across public bodies between 2003 and 2021. This information allows us to capture variation in auditing intensity, which is a key determinant of procurement behavior and associated cost implications.

4 Public Procurement distortion

We first exploit the existence of thresholds for each procurement procedure during the period to identify and quantify behavioral responses around these cutoffs. Following the bunching literature, in the absence of thresholds the distribution of procurement amounts should be smooth, as buyers select the most suitable procedure. However, when thresholds restrict the use of simpler procedures for larger contracts, procurement amounts may cluster just below the cutoff to avoid more burdensome and costly procedures. Since more stringent procedures involve higher administrative and operational costs, procurement officers may adjust purchasing decisions in response to these discontinuities.

To identify these behavioral responses, we estimate a counterfactual distribution by fitting a flexible polynomial to the observed distribution of procurement amounts, excluding a window around the threshold (bunching region). The difference between the actual procurement in the area of interest and the

[7] This is a global standard that allows visualizing the cycle (opening, award, and implementation) of each contract carried out by a public office. This information is systematically updated once a day, so it is fully representative of the current status of the phenomenon Partnership (2022).

counterfactual distribution represents the level of distortion.[8] We can estimate this for the entire period, yearly, or by subdividing the sample to capture heterogeneity.[9]

Secondly, we analyze two significant threshold changes: one in 2012 that doubled the threshold, and another in 2020 that reduced it to one-third. We aim to analyze how public buyers change their procurement behavior in response to these changes. Additionally, we consider distortion under a different definition where the counterfactual is a situation with a smaller or larger threshold, following Carril (2021). We build a different counterfactual based on whether the threshold changes, considering both the extensive and intensive margins of distortion, with the pre-change threshold as the counterfactual distribution.

In both estimations, the counterfactual follows Equation 1. To estimate the distortion due to the existence of a threshold, the outcome is the number of procurement in bin j, denoted as $c_j = n_j$. For the analysis of the effect of threshold changes, the outcome is $RFC_j = \frac{n_j^{post}}{n_j^{pre}} - 1$.

$$c_j = \sum_{k=0}^{p} \beta_k (z_j)^k + \sum_{i \in R} \gamma_i \mathbb{1}(z_j = i) + \nu_j \tag{1}$$

In Equation 1, we define $R = [m_L, m_U]$ as the excluded region, c_j is the counterfactual in bin j, z_j is the amount of procurement in bin j, and p is the order of the polynomial. The estimated counterfactual is $\hat{c}_j$, which is estimated without the excluded region.

$$\hat{c}_j = \sum_{k=0}^{p} \hat{\beta}_k (z_j)^k \tag{2}$$

As in Kleven and Waseem (2013), c_j is the number of procurements in bin j (n_j). To quantify the bunching, we compare the actual distribution with the counterfactual using Equation 3, and finally, the relative excess mass ($\hat{B}_{KW}$) and the missing mass ($\hat{M}_{KW}$) are shown in Equation 3.[10]

$$\begin{aligned} \hat{B}_{KW} &= \sum_{j=m_L}^{m_0} (n_j - \hat{n}_j) \\ \hat{M}_{KW} &= \sum_{j=m_0}^{m_U} (\hat{n}_j - n_j) \end{aligned} \tag{3}$$

The excess mass can be computed relative to the average density of the counterfactual estimation in the distortion area below the threshold with N as the number of bins in the region $[m_L, m_0]$:

$$\hat{b}_{KW} = \frac{\hat{B}_{KW}}{\frac{1}{N}\sum_{j=m_L}^{m_0} \hat{n}_j} \tag{4}$$

In Carril (2021), the counterfactual frequencies are estimated from the figures before the policy change:

[8] See panel a) of Figure B.2.

[9] Purchases made under the "exception" mechanism are excluded from the analysis, since such purchases are not subject to any type of limit and their use is generally made under specific circumstances.

[10] In panel a) of Figure B.2, the areas A and B represent the excess and missing mass, respectively.

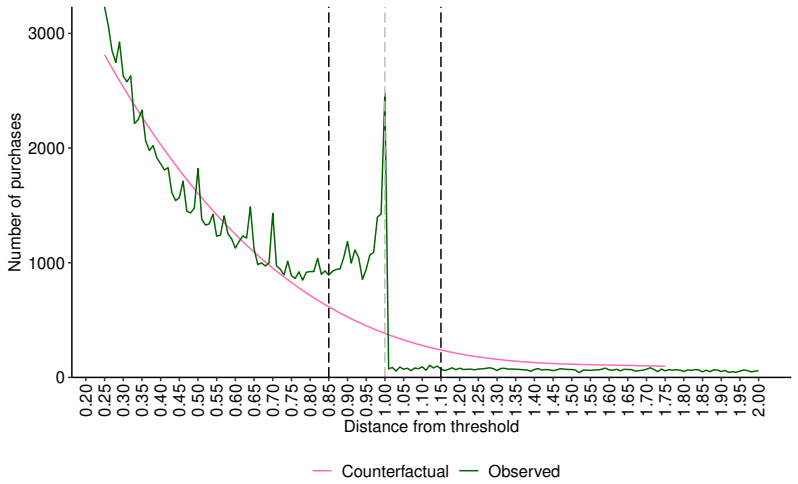
$n_j = n_j^{pre}(1 + \hat{c}_j)$, and the excess mass and missing mass in the case of a rise in the threshold are:

$$\hat{B}_C = \frac{\sum_{j=m_{0\,pre}}^{m_U}(n_j^{post} - \hat{n}_b)}{\sum_{j=m_L}^{m_U}\hat{n}_j/(m_U - m_L)}$$
$$\hat{M}_C = \frac{\sum_{j=m_{0\,pre}}^{m_L}(\hat{n}_b - n_j^{post})}{\sum_{j=m_L}^{m_U}\hat{n}_j/(m_U - m_L)} \tag{5}$$

Carril (2021) explores the law flexibilization with the rise in the threshold, and we expand the analysis to a decrement in the threshold (more regulation).[11]

Given the different thresholds (see Figure 2), we normalize the bin to the current direct purchase threshold. We observe relevant bunching just before the threshold relative to the counterfactual, following the procedure of Kleven and Waseem (2013) as explained in Equations 1 to 4. Our prefer estimation is the overall impact for the period 2011-2021 because the system reach a relevant take-up (Figure 1), and we can capture posterior changes of rules. We also provide estimates for the entire period (2002-2021) as shown in Figure B.3. We then specifically estimate the effect of threshold changes in terms of distortion for both threshold increases and decreases.

Figure 3: Bunching visualization (2011-2021)



Note: The figure displays the observed and counterfactual distribution of public procurement during the period 2011-2021. On the horizontal axis, procurement amounts are grouped into bins relative to the current threshold for using the 'Direct procurement' procedure. The vertical axis represents the number of procurement within each bin. The green line represents the observed number of procurement, while the pink line represents the counterfactual estimation based on Kleven and Waseem (2013). Vertical dashed lines indicate the boundaries of the exclusion region. Vertical black dashed lines denote the boundaries of the exclusion region, while the vertical gray dashed line represents a scenario where the purchase value is exactly equal to the threshold.

In Figure 4, we show the estimation of each bunching model yearly and in the two subperiods.[12] In our preferred setting, we quantify the excess of purchases below the threshold at around 3900 purchases ($\hat{B}_{KW} - \hat{M}_{KW}$ in Equation 3). The relative excess mass ($\hat{b}_{KW}$ in Equation 4) is estimated at 0.076. For this period, there is significant shift towards procedures with less bureaucratic burden and a lower level of control.

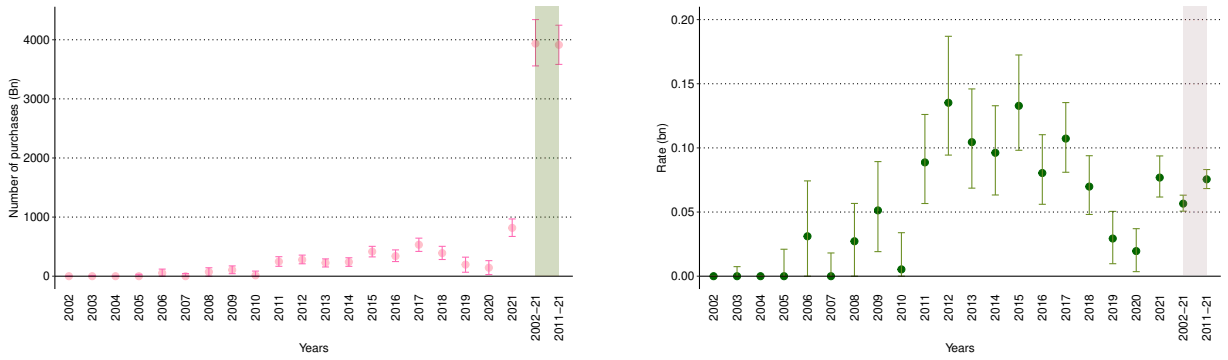
We estimate the distortion by B_n and b_n for the whole period. In Figure 4, we show the number of

[11] In panel b) of Figure B.2, the C area represents the intensive margin of the change, and $D - E - C$ represents the extensive margin. In panel c), the scenario depicts more regulation.

[12] The estimation is shown in Table B.2 in the Appendix.

purchases distorted yearly and over the entire period. Up to 2010, there was practically no distortion due to the threshold, likely due to insufficient power to estimate it. Between 2011 and 2020, the number of distorted purchases was around 250 per year, but in 2021, there was a jump to 800. The relative excess mass was zero until 2010, then it rose to around 0.07 until 2017 when it declined to around 0.04. In 2021, there was a new increase in relative distortion to around 0.07.

Figure 4: Bunching estimation (2002-2021)



(a) Procurement distortion in purchases, 2002-2021

(b) Procurement distortion in rates, 2002-2021

Note: The left panel shows the observed number of distorted procurement in the interest area B_n. The right panel illustrates the rate of distorted procurement in the interest area. distorted procurement are those above the counterfactual distribution in each year of the period. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The colored area show the estimation for the period 2002-2021 and 2011-2021.

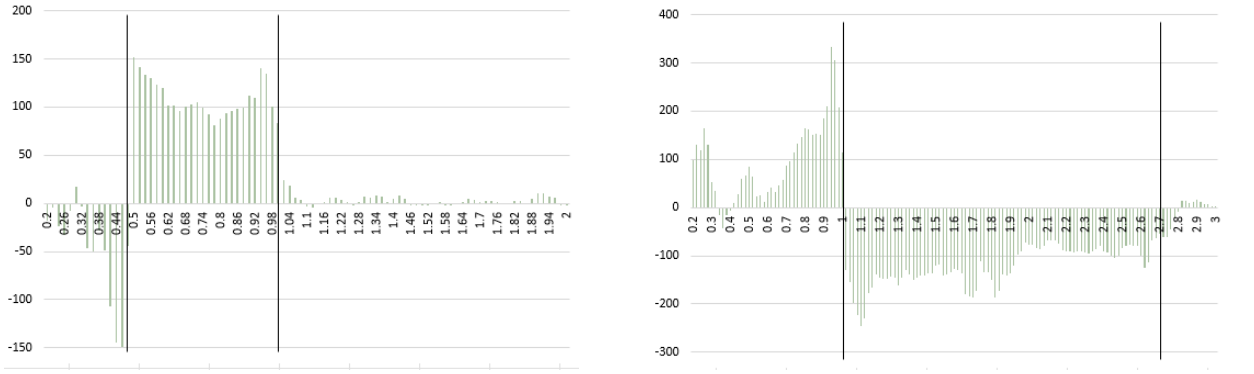
During the period, two major changes in procurement thresholds provide variation to study behavioral responses. The bunching estimates based on the counterfactual proposed by Kleven and Waseem (2013) do not account for the presence of a pre-existing threshold prior to the reform. To address this limitation, we construct an alternative counterfactual following Carril (2021), which incorporates the pre-policy threshold and allows us to identify the change in behavior induced by the reform.

We zoom now in the bunching results derived from the regulatory changes that occurred in 2012 and 2020 (detailed in Figure 2). As mentioned, in 2012, the government threshold for Direct Procurement doubled; in 2020 it reduced to less than half. This variation allows us to replicate our previous estimation but in contexts where public officers have more or fewer incentives to adjust procurement decisions in response to procedural costs.

In Figure 5, we show the net purchase change in each award's bin as the threshold change. The bin one is the new threshold, and it is remarkable how the change in the threshold impact in the behavior of the public buyer, bunching just behind the new threshold. The left figure show the less stringent threshold of 2012, there are a net decrease of 600 purchases just before of the older threshold and increment of 3000 between the old and the new one. The right figure show the stricter threshold of 2020, there are a net decrease of 10000 purchases between the old threshold and the new one; just before of the new threshold and increment of 4000.

In Figure 6, we estimate this behavioral purchasing change through bunching using as counterfactual the distribution before the threshold change. In the left panel, there is the change of 2012 (loosing regulation) and in the right panel those of 2020 (stricter regulation). That is clear again how instantaneous is the buyer change of purchase behavior to move just below the thresholds, indicating the higher cost

Figure 5: Net purchase change as threshold change in 2012 and 2020



(a) Net change in purchase by award, 2011-2013

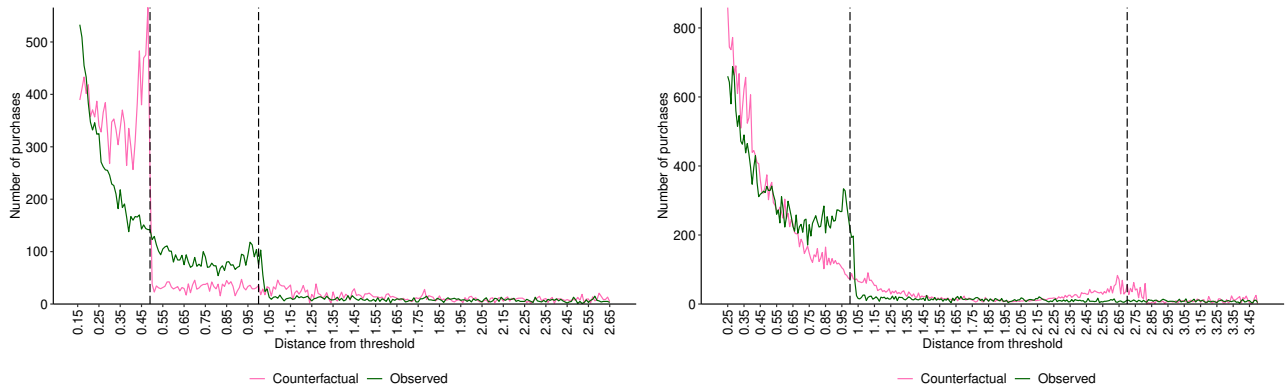
(b) Net change in purchase by award, 2019-2021

Note: The figures illustrate the difference in the number of purchases based on bin awards when thresholds changed in 2012 and 2020. In the left panel, the figure depicts the net purchase change between 2011 and 2013. The vertical lines represent the new threshold (normalized to one) and the old threshold at 0.48. In the right panel, the figure displays the net purchase change between 2019 and 2021. The vertical lines represent the new threshold (normalized to one) and the old threshold at 2.7.

that any auction carry on for them.

In the Table 1, we report the estimation of the Equation 5. We observe a higher intensive change as the regulations is less stringent and a higher extensive one as the regulation become stricter. Whether regulations is less stringent more purchases can be done by a simplified procedure then we observe a higher mass just below the new threshold. Contrary, as the threshold became stricter, there are a higher extensive reaction, there is a strong extensive response, with a reduction or reallocation of purchases around the threshold. These results are in line with the Figure 5. In short, public buyers adjust procurement decisions in response to threshold changes, reacting immediately and asymmetrically depending on the direction of the policy change.

Figure 6: Distortion in the Threshold Changes



(a) Bunching visualization (2012 reform)

(b) Bunching visualization (2020 reform)

Note: The left panel of figure shows the observed distribution of the public procurement from the second semester of 2012 to the first semester of 2014 (i.e. two years after the reform) and the counterfactual distribution, using the data for the second semester of 2010 to the first semester of 2012 (i.e. two years before the reform). The right panel shows the observed distribution of the public procurement from the second semester of 2020 and 2021 and the counterfactual distribution using the data for 2019 and the first semester of 2020. counterfactual distributions were constructed following the methodology of Carril (2021). The vertical dashed lines are the threshold limits before and after the reform. In the horizontal axis appear the procurement amount in bins respect to the post-reform threshold to use the *Direct procurement* procedure. The vertical axis are the number of procurement in each bin.

Table 1: Distortion in the Threshold Changes

	Intensive	Extensive	Excess mass (B_C)	Missing mass (M_C)	Net excess mass ($B_C - M_C$)
2012 change	3075	-972	0.276	0.342	-0.066
2020 change	861	2326	0.167	0.044	0.123

Note: The first column is the numerator of the first term in Equation 5, that is $\sum_{j=m_{0pre}}^{m_U}(n_j^{post} - \hat{n}_b)$. The second column is the numerator of the second term in Equation 5, that is $\sum_{m_L}^{j=m_{0pre}}(\hat{n}_b) - n_j^{post}$. The third and fourth columns are the terms in Equation 5, that are: $\hat{B}_C = \frac{\sum_{j=m_{0pre}}^{m_U}(n_j^{post} - \hat{n}_b)}{\sum_{j=m_L}^{m_U}\hat{n}_j/(m_U - m_L)}$ and $\hat{M}_C = \frac{\sum_{m_L}^{j=m_{0pre}}(\hat{n}_b) - n_j^{post}}{\sum_{j=m_L}^{m_U}\hat{n}_j/(m_U - m_L)}$ respectively.

5 Behavioral Responses and Procurement Outcomes

When and who respond?

We have established that procurement thresholds generate behavioral distortions, and that public buyers respond immediately to changes in regulation. We now examine the anatomy of these responses by identifying and quantifying them across different purchase characteristics: time of year, type and size of organizations, and past performance. To do so, we split the sample and apply the bunching analysis to estimate the extent of these distortions.

Our first objective is to determine the relevance of the timing of purchases in relation to distortion. Previous literature suggests that purchases are more concentrated towards the end of the year as organizations strive to exhaust their allocated budgets (Liebman and Mahoney, 2017; Baumann, 2019). Notably, research conducted on Uruguayan data by Silva (2020) has documented a phenomenon known as procurement procrastination.

In panel a) of Figures 7, we illustrate the findings regarding distortion across different quarters of the year. The results reveal significantly higher distortions during the third and fourth quarters, approximately doubling relative to the first half of the year. In the first semester, the distortion rate is around 5%, while in the second semester it rises to 10%.[13] This indicates that not only are there more purchases close to the end of the year, as documented by Silva (2020), but there is also more distortion.

We further investigate distortion based on the type of organism involved in procurement. To examine this, we distinguish between the central administration (Ministries and Parliament), local governments, and other entities such as public health providers, education providers, and public firms (banks, energy, water services). These three groups are subject to different legislative frameworks for budget definition and expenditure.[14]

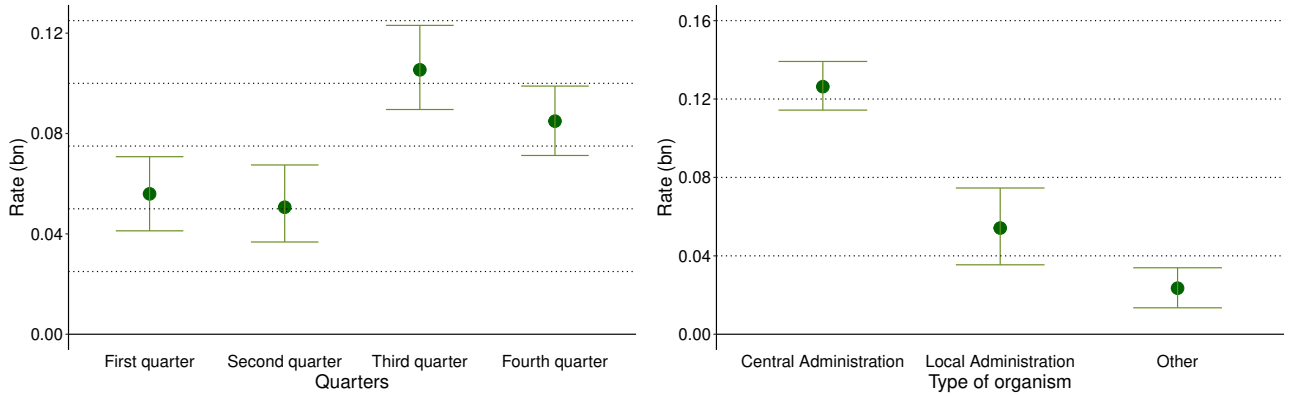
Our findings show that the central administration, which operates under more stringent regulations, exhibits a higher level of distortion compared to the other groups, as seen in panel b) of Figure 7. The rate of distorted purchases represents more than 12% of the purchases in the interest area. While these entities account for a larger number of recorded purchases, they also exhibit higher distortion rates, suggesting stronger behavioral responses to procurement thresholds.

We also investigate the relationship between distortion and the level of auditing conducted on each organism during the period. To analyze this, we utilize data obtained from the Auditing Office (*Tribunal*

[13] In Figure B.4, we show that this represents 1500 distorted purchases versus 750.

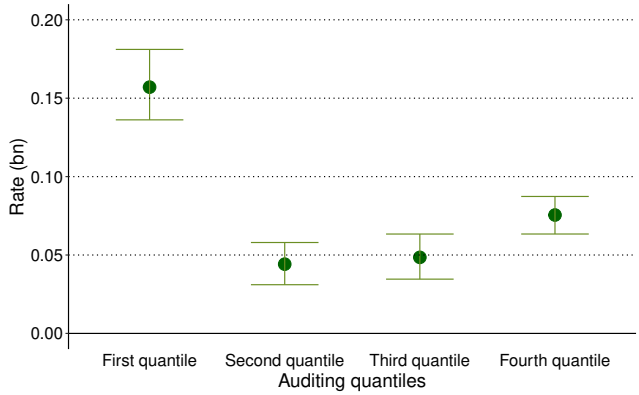
[14] See TOCAF: https://www.comprasestatales.gub.uy/ManualesDeUsuarios/manual-procedimiento-compras/TOCAF.html

Figure 7

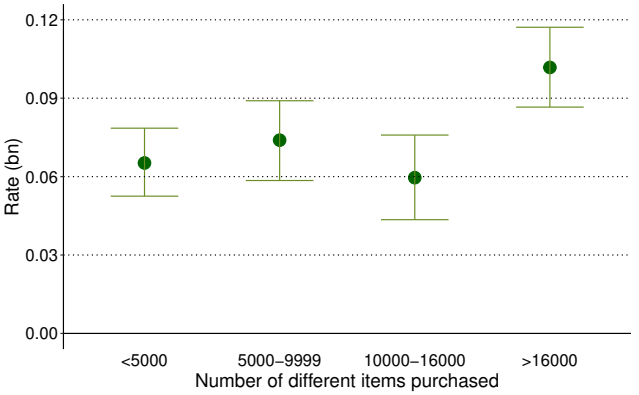


(a) Distortion by quarter in the year

(b) Distortion by type of buyer



(c) Distortion by auditing intensity



(d) Distortion by number of different items purchased

Note: The top left panel show the amount of distorted purchases B_n estimated by quarter in the year. distorted procurement are those above the counterfactual distribution. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The top right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by quarter in the year. The bottom left panel show the amount of distorted purchases B_n estimated by auditing intensity. The bottom right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by auditing intensity.

de Cuentas). We construct a ratio by dividing the number of audits and observations received by each organism by the total number of procurements. Subsequently, we create quartiles based on these ratios and calculate the level of distortion within the fourth quartile. In panel c) of Figure 7, we observe a U-shaped pattern in distortion by auditing. Buyers with both the lowest and highest levels of auditing exhibit substantially higher distortion levels than those in the middle, suggesting a non-linear relationship between oversight and behavioral responses. In terms of the rate of distortion, those organisms with less control manipulate 15% of their purchases, while those in the middle manipulate 5%, and those with more audits manipulate 7%, making the U-shape less clear.

Finally, in panel d) of Figure 7, we investigate whether the number of different items that an organism buys can lead to heterogeneous results. We find that those organisms that buy 16 thousand different products manipulate more in both absolute and relative terms, with 1600 distorted purchases representing 10%. As many purchases include more than one item, it is expected that organisms buying a wide variety of items have more opportunities to manipulate.

We also present results by the number of buyers within each unit and the number of employees in

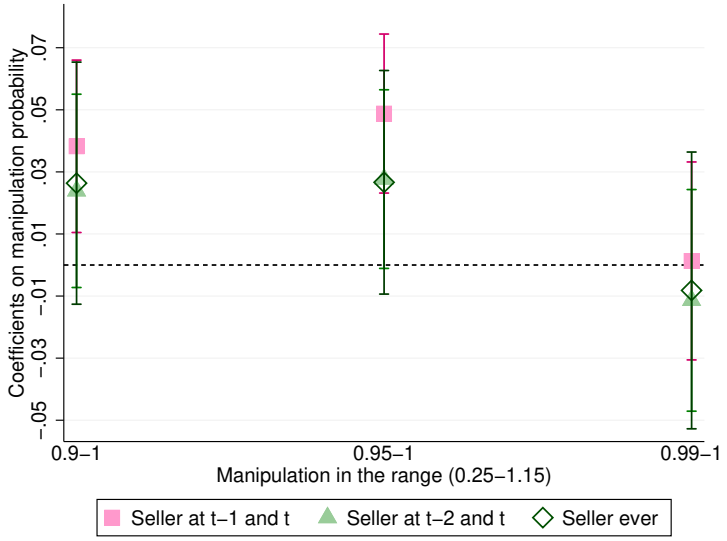
Figures B.6 and B.7. In the first case, there is an inverted U-shaped pattern, while for employees and items, there is no clear pattern in terms of the number of purchases.

Mechanisms and Cost Implications

Here, we aim to estimate the effect of repeating the same seller in the same office on the probability of distortion. We want to determine if the familiarity of certain firms with the procurement office can lead to more distortion. We use three definitions of distorted purchases: those in the 10%, 5%, and 1% closest behind the threshold.

In Figure 8, we show that when the purchase is made with the same seller as the year before, there is an increase in the probability of distortion by between 3 and 5 percentage points. However, this effect has a short memory because if we define the repeated seller as one used two years before or as any seller that has ever sold to the office, we do not find a significant effect. These effects are mainly observed in organisms that are part of the Central Administration (see Table B.5), which are the entities that manipulate the most.

Figure 8: Probability of distort: repeated seller



Note: We define a repeated seller as those who sells to the same office in the organism in different moment of time before to the actual purchase. We consider those in the year before, in the last 2 years or in any time before. We perform a probit model with all observable available and we graph the marginal effect in three measures of distortion.

To assess the quality of the goods purchased in distorted processes, we compute unit prices for all items. We then standardize prices by item and year and identify overpriced items. In both panels of Figure 9, we examine the association between distorted purchases and goods prices.

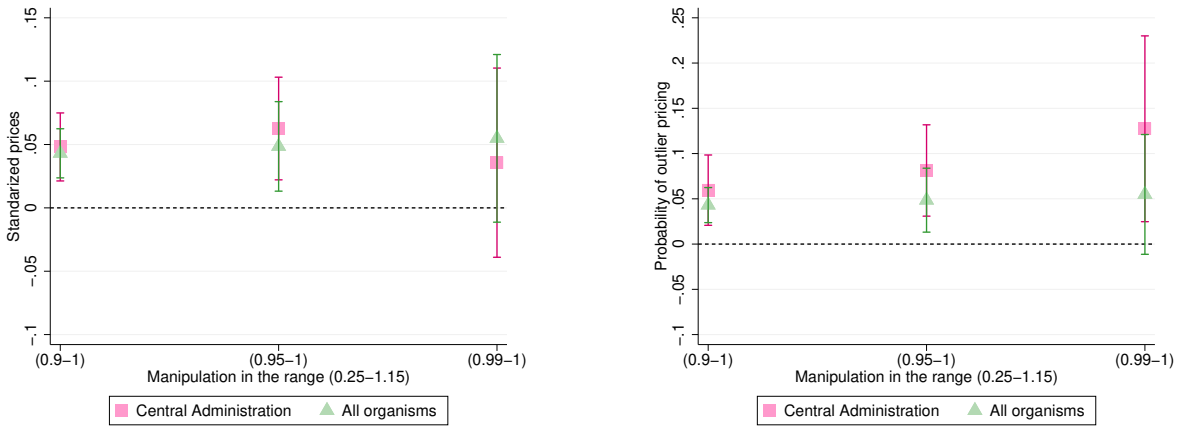
The left panel shows the relationship with standardized prices using the three definitions of distortion. We observe in panel a) an increase of about 0.05 standard deviations in prices, indicating higher procurement costs associated with these purchasing decisions, even after controlling for buyer and procurement procedure fixed effects. In panel b), we find an increase of between 5 and 10 percentage points in the probability that an item is overpriced, also robust to the inclusion of these fixed effects.

These results suggest that the observed price differences are not driven by systematic differences across

contracting authorities or procurement procedures, but instead reflect differences in purchasing decisions around the threshold.

These findings are consistent with the literature showing that less competitive and more discretionary procedures are associated with higher prices. While we cannot fully rule out unobserved differences in product characteristics or demand conditions, the consistency of these results across specifications provides strong evidence that these purchasing patterns are associated with higher procurement costs.

Figure 9: Distortion on prices



(a) Distortion on standardized prices

(b) Distortion on outlier pricing

Note: The left panel reports the association between distorted purchases and standardized prices. The right panel presents estimates from a probit model of the probability that a purchase has an outlier price. All specifications include buyer and procurement procedure fixed effects.

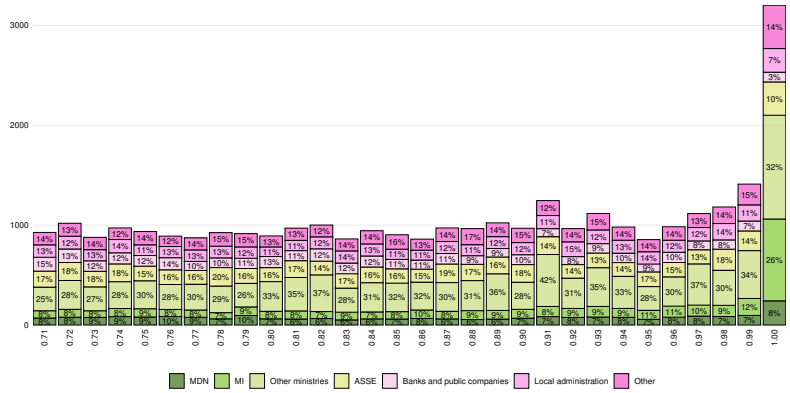
Bunch Composition

Next, we want to analyze the bunch composition just behind the thresholds within the interest area, as shown in Figure 10. There are two ministries (Interior and Defense) that are the main buyers in the Central Administration. Another major buyer is the public health provider (ASSE). In the last bin behind the threshold, we observe some changes compared to the other bins. Firstly, there is an increase of 14 percentage points (almost double) in the participation of the Interior Ministry, and a decrease in the participation of all other buyers.[15]

To analyze what happens in the distorted purchases area we observe the four panels of Figure 11. The left panels show changes in the types of goods, and the right panels show changes in buyers. When the threshold is less stringent, there is a minor participation of general goods (materials and supplies) and an increase in participation of construction, improvements, and repairs. As the threshold becomes larger, new categories of expenditures can apply to *Direct Purchase*, and general goods have less presence close to the threshold (panel a)). The opposite reaction is observed in panel c) when the threshold is stricter.

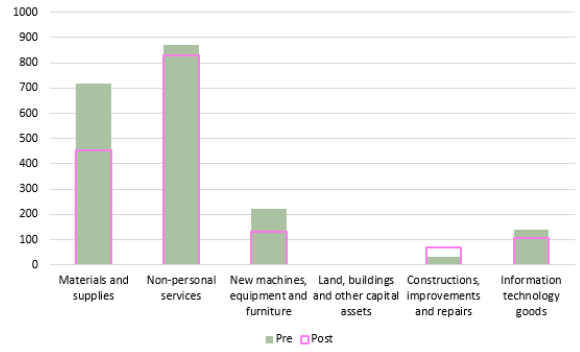
[15]Figure B.9 compares last-bin composition across three periods. Before 2012, Defense increased its share (+5 p.p., +31%). With a looser threshold, Interior became dominant (+15 p.p., +115%). Under stricter rules, Interior still led (+12 p.p., +109%). Over time, Defense declines, Interior remains central, and ASSE rises, possibly reflecting COVID-19 effects.

Figure 10: Bunch buyer Composition 2011-2021

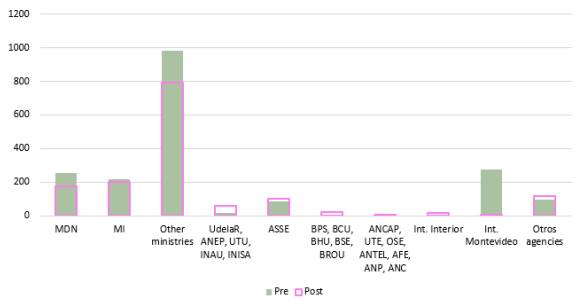


Note: The graph show the buyer participation in each of the awards bins behind the threshold in the period 2011-2021.

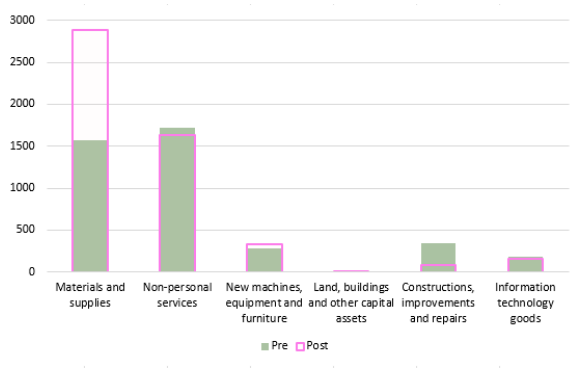
Figure 11: distorted Purchases Changes



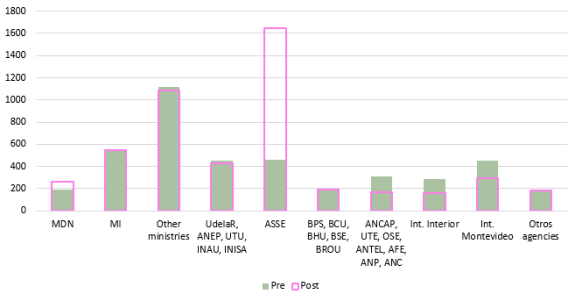
(a) Change in family goods (less stringent threshold)



(b) Change in buyers (less stringent threshold)



(c) Change in family goods (stricter threshold)



(d) Change in buyers (stricter threshold)

Note: The graph show the change in the number of purchase done in the interest area behind the threshold before (green) and after (pink) the threshold change of July 2012. In the left panel there is the change of family products bought before and after, and in the right one, the change by buyers. The graph show the change in the number of purchase done in the interest area behind the threshold before (green) and after (pink) the threshold change of July 2020. In the left panel there is the change of family products bought before and after, and in the right one, the change by buyers.

6 Cost Procurement Model

Finally, to interpret the behavioral responses around procurement thresholds, we develop a simple model in which buyers face a trade-off between the value of procurement and the costs associated with more transparent procedures. The model allows us to infer the implicit cost of complying with more stringent procurement rules from observed behavior around the threshold.

We develop a simple model to recover the implicit cost function consistent with the observed procurement behavior when a purchase exceeds the threshold for more stringent procedures. The model captures the trade-off between the value of the procurement and the administrative and operational costs associated with more transparent procedures. We consider a buyer who chooses the procurement award (p), obtaining utility from the value of the purchase (ν), but incurring both the monetary cost of the award (p) and the procedural cost $c(\nu)$. The procedural cost depends on the scale of the procurement, captured by ν, as larger or more valuable purchases trigger more demanding and costly procedures. The buyers objective is to maximize the net benefit from the procurement, defined as the value of the purchase minus both the procurement price and the procedural cost. Importantly, this cost function should be interpreted as an implicit or revealed procedural cost that rationalizes the observed behavior under the model assumptions.

$$\max_{p} U(\nu - c(\nu) - p) \tag{6}$$

Assuming an interior solution, the optimal procurement award equates the marginal benefit of the purchase to its marginal cost, which includes both the procurement price and the procedural cost. Proposing a general specification of the utility function $U(p) = \frac{1}{1-\delta}\big(\nu - c(\nu) - p\big)^{1-\delta}$, which implies:

$$\begin{aligned} \nu - c(\nu) - p &= 0 \\ p &= \nu - c(\nu) \end{aligned} \tag{7}$$

Public buyers decide the award based on their own value and the cost of dealing with the procurement. Following Carril (2021), we assume that the public buyer's value ν_i is log-normally distributed:

$$\nu_i \sim \text{LogNormal}(\mu, \sigma) \tag{8}$$

The cost function depends on the procurement regulation, as shown in Figure 2. We consider only those procurements around the threshold between direct purchase and the shortened auction. The cost is zero when the value is below the threshold, takes a positive value just above the threshold, and is given by the following function above the threshold:

$$c(\nu_i) = \begin{cases} 0 & \nu_i \leq \overline{p} \\ \alpha + (\nu_i - 1)^{\gamma} & \nu_i > \overline{p} \end{cases} \tag{9}$$

For purchases where $\overline{p} < \nu_i < \overline{p} + \delta$, public buyers receive a shock $e_i \in U[\epsilon_1, \epsilon_2]$ that increases the effective cost of using the more stringent procedure. In this case, the procurement outcome becomes $\nu_i - c(\nu_i) - (1 + \delta)e_i$.

We estimate the model using public procurement data from 2002 to 2021. We estimate the set of parameters (θ) through the simulated method of moments using 132 bin moments around the threshold.[16]

$$\theta = (\mu, \sigma, \alpha, \gamma, \delta, \epsilon_1, \epsilon_2) \tag{10}$$

$$\hat{\theta} = \text{argmin}_\theta (m_n - m_s(\theta))' W_n (m_n - m_s(\theta)) \tag{11}$$

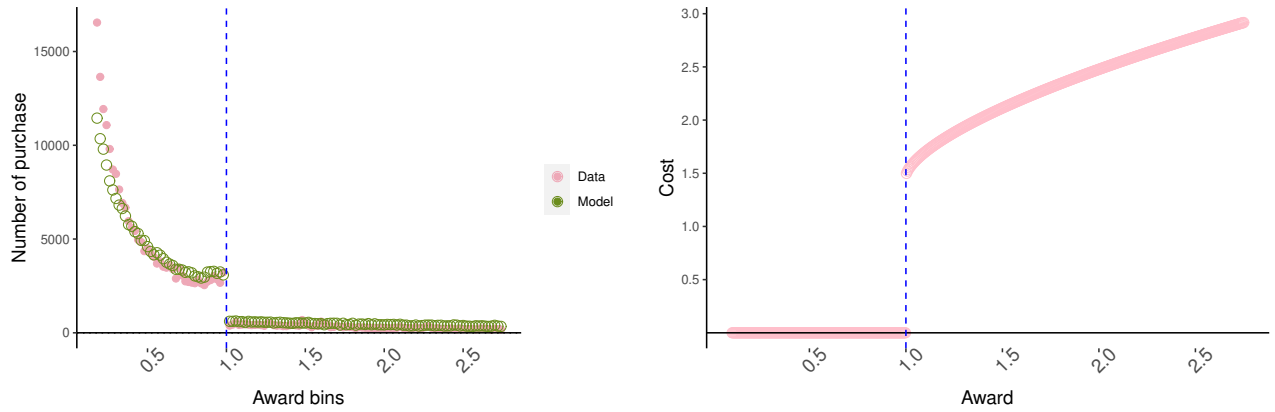
The model estimation is presented in Table 2. We present the seven parameters that shape the purchase award function (μ and σ), the cost function (α and γ), and the shock (δ, ϵ_1, and ϵ_2). The shape of the award function is similar to that estimated by Carril (2021), but with a steeper descending part, as we work with a wider set of purchases and focus on the left part of the distribution.

Table 2: Parameter estimation

	Estimate	Standard Error	CI Lower	CI Upper
μ	0.03	0.05	-0.06	0.11
σ	6.40	0.03	6.35	6.47
α	1.48	0.03	1.44	1.53
γ	0.65	0.02	0.61	0.69
δ	0.05	0.01	0.03	0.07
ϵ_1	0.00	0.00	0.00	0.01
ϵ_2	0.15	0.01	0.12	0.18

Note: We estimate the model using data from the public procurement since 2002 to 2021. We estimate the set of parameters (θ) through the simulated method of moments using 132 bin moments around the threshold. We normalize the purchase award using the threshold at each moment and consider those awards between 0.1 and 2.75.

Figure 12: Model fits and cost function



(a) Model fits

(b) Cost function

Note: The left panel is the model fit: the green dots are the number of purchases estimated by the model and the pink ones, are those that came from the data. The cost function in the right panel is zero till the threshold and after that there is a jump in the threshold.

Both panels of Figure 12 present the model fit using the parameters reported in Table 2 and the implied cost function. The model replicates the bunching observed just below the threshold and yields a cost function indicating that the implied administrative and procedural burden associated with more

[16] We normalize the purchase award using the threshold at each moment and consider those awards between 0.1 and 2.75.

stringent procedures is substantial, equivalent to approximately 150% of the procurement award at the threshold. This estimate should be interpreted as a revealed procedural cost that rationalizes the observed behavior under the model assumptions, rather than as a direct measure of administrative expenditure.

7 Conclusions

This paper examines how public buyers respond to procurement regulations using a comprehensive administrative database covering all public procurement activities conducted by government offices in Uruguay between 2002 and 2021. Building on the bunching methodology of Kleven and Waseem (2013) and extending the framework of Carril (2021), we quantify behavioral distortions around procurement thresholds and analyze how changes in regulation affect purchasing decisions. We further assess the impact of these regulatory changes by constructing counterfactual scenarios.

Our analysis shows that procurement thresholds generate significant distortions in purchasing behavior, affecting approximately 4,000 purchases, or 7.5% of procurement in the relevant range. These distortions are more pronounced in the second half of the year, particularly in the third and fourth quarters, consistent with procurement procrastination. We also find that distortions are more prevalent among organizations subject to more stringent regulations and among those with lower levels of auditing.

Exploiting two major threshold reforms, we document that behavioral responses are immediate and asymmetric. Tightening thresholds (more stringent regulation) leads to an increase in distortions, while relaxing thresholds reduces them. When accounting for the pre-existing threshold using alternative counterfactuals, we find that the magnitude and nature of the response depend critically on the direction of the policy change.

We also identify key mechanisms underlying these responses. Repeated interactions between buyers and suppliers increase the likelihood of distortions by between 3 and 6 percentage points. Importantly, these distortions have measurable cost implications: purchases affected by them are associated with higher prices, both in terms of standardized price measures and the probability of being overpriced.

Taken together, our findings suggest that public buyers adjust procurement decisions in response to regulatory thresholds, particularly when faced with more demanding procedures or time constraints. These behavioral responses lead to distortions in procurement decisions and are associated with higher procurement costs.

Finally, using a structural model, we quantify the implicit cost of complying with more stringent procurement procedures, as revealed by behavior around the threshold. We find that the administrative and procedural burden associated with these procedures is substantial, equivalent to approximately 150% of the procurement award at the threshold. This result highlights the importance of considering the trade-off between transparency and cost in the design of procurement systems. While more transparent procedures enhance accountability and competition, they may also impose significant costs that shape purchasing behavior. Although these responses reflect rational adjustments to procedural costs, they may lead to outcomes that deviate from those that would arise under frictionless procurement.

Overall, our results underscore the importance of carefully designing procurement rules that balance transparency and control with administrative feasibility and cost efficiency.

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A Data Cleaning

The original database had a string format for all purchases made between 2002 and 2021, so it was necessary to encode each one of the variables. In addition, in some cases it was necessary to web-scrape ARCE's website to retrieved some missing information.

To standardize information, the data format gives an unique identifier for each item in the database (product or service). This allow comparisons of same categories of goods or services. However, in the original database, this identifier was missing in about 20% of the records. So, it was necessary to assign the corresponding identifier by using a name (character) variable. Although this allowed us to recover a big part of the identifiers, in some cases it was not possible because the written name differed substantially from the code description.

Finally, there are some discrepancies between the number of purchases that exist in the database and those that exist on ARCE's website. This was mainly because of canceled purchases. A total of 2,599 purchases were deleted from our database because of this reason.

The final database includes 2,670,033 items purchased in 984,536 unique purchases [17], of which 71.5% correspond to the period 2010-2021. For these purchased items, there is complete information of 88.5% of records. That includes: the item's id, buyer, price paid, currency, quantities, procurement procedure, and supplier.

B Tables and Figures

Figure B.1: Share of procurement procedures

(a) Share by procurement procedure (quantity)

(b) Share by procurement procedure (amount)

Note:

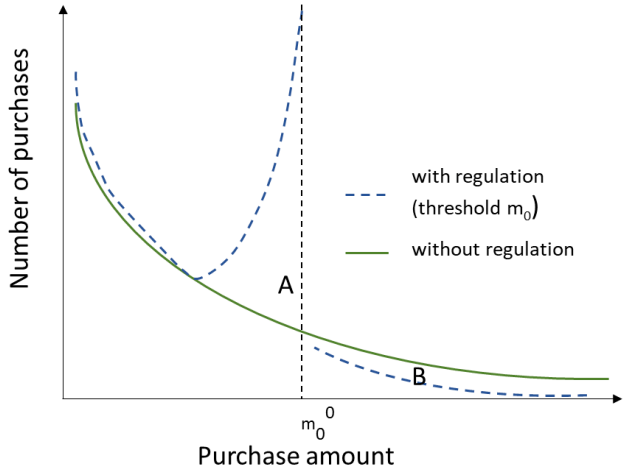
[17] In a single purchase can be acquired multiple items.

Table B.1: Descriptive statistics

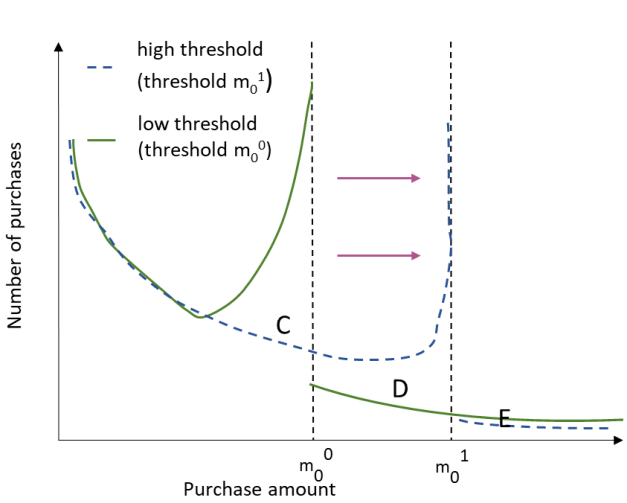
		N purchases	N items	N buyers	N suppliers
Total		984516	39187	387	29836
By year	2002-2004	75368	1277	35	3713
	2005-2009	205605	9441	118	5097
	2010-2014	208407	7958	72	5128
	2015-2019	334862	12833	105	10229
	2020-2021	160274	7735	73	5776
By quarter	First quarter	205499	7025	60	5755
	Second quarter	239069	9354	103	6812
	Third quarter	261232	10476	103	7895
	Fourth quarter	278716	12416	122	9448
By type of organism	Central administration	622056	24729	208	17654
	Local administration	85478	2613	29	3003
	Other	276982	11720	150	8233
By auditing ratio	First quantile	215304	8471	32	4647
	Second quantile	314906	17250	196	8154
	Third quantile	134645	4818	17	2871
	Fourth quantile	266724	7672	114	11523
By number of purchasing units	One or two	227809	4762	59	8343
	Between 3 and 10	241371	8021	71	7896
	Between 11 and 50	315403	15587	98	9406
	More than 50	199933	10869	158	4172
By number of employees	Less than 1000	175541	5208	117	5385
	Between 1000 and 4999	360048	10272	95	12130
	Between 5000 and 30000	263679	15493	120	6993
	More than 30000	185248	8123	55	5245
By number of different items purchased	Less than 5000	234682	4481	97	9814
	Between 5000 and 9999	220069	7164	69	7865
	Between 10000 and 16000	195823	8197	92	4153
	More than 16000	333941	19194	128	8042

Note:

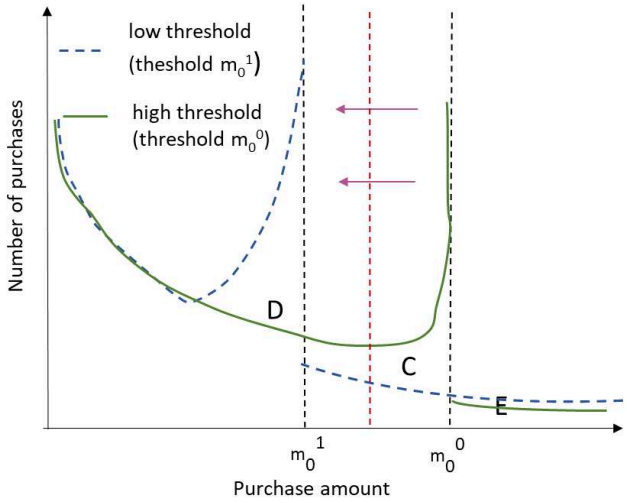
Figure B.2: Bunching definition



(a) Threshold inclusion



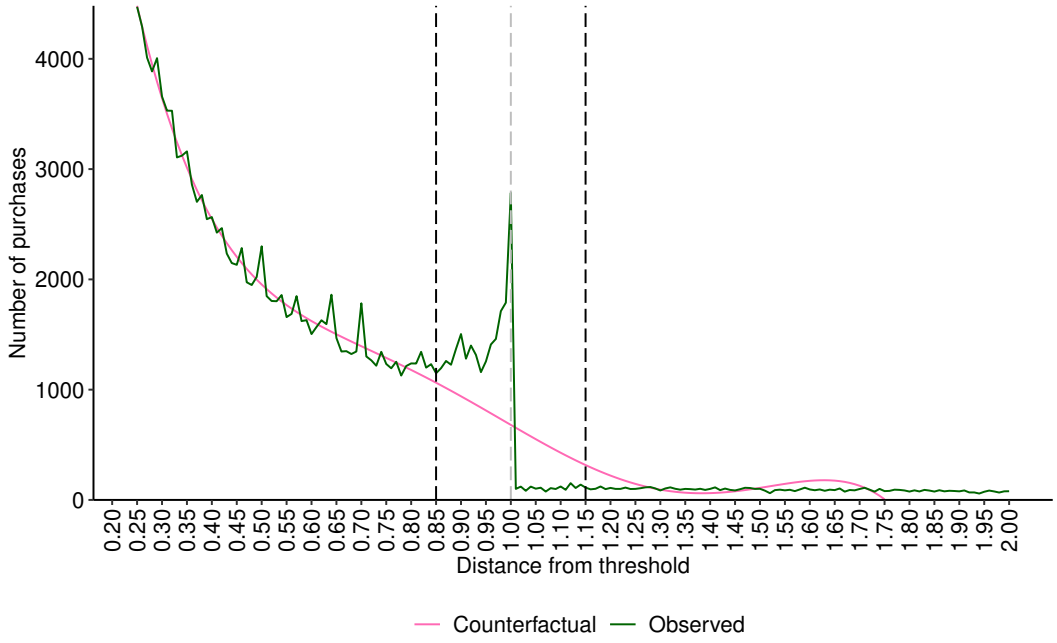
(b) Threshold rise



(c) Threshold decrement

Note: The first two panels of this Figure appear in a similar shape to Figure 2 in Carril (2021). The first panel shows the comparison before and after the introduction of regulation as a threshold. The straight green line is the situation without regulation, and it is commonly the counterfactual used to estimate the distortion due to introducing a threshold. The dashed blue line is the threshold response, bunching immediately before it. The second panel shows the comparison when there is a rule flexibility with increasing the thresholds that allow using a simpler procedure. Instead, to use a counterfactual without regulation, we construct the counterfactual with a lower threshold. Finally, the third panel shows a change for stricter rules. In this case, we restrict area C to the same bins that the area D.

Figure B.3: Bunching estimation (2002-2021)



Note: The figure shows the observed and the counterfactual distribution of the public procurement in the period 2002-2021. In the horizontal axis appear the procurement amount in bins respect to the current threshold to use the *Direct Procurement* procedure. The vertical axis are the number of procurement in each bin. The green line is the observed number of procurement, and the pink line is the counterfactual estimated following Kleven and Waseem (2013). Vertical black dashed lines are the boundaries of the exclusion region, while the vertical gray dashed line is the case when the value of the purchase is exactly the same as the value of the threshold.

Table B.2: Excess of mass

Year	Bn	std(Bn)	BIC5	BIC95	bn	std(b)	bIC5	bIC95
2002	0.00	0.91	0.00	0.00	0.000	0.002	0.000	0.000
2003	0.00	5.99	0.00	12.04	0.000	0.004	0.000	0.007
2004	0.00	2.30	0.00	0.00	0.000	0.001	0.000	0.000
2005	0.00	11.45	0.00	31.75	0.000	0.008	0.000	0.021
2006	54.39	35.71	0.00	120.18	0.031	0.022	0.000	0.074
2007	0.00	17.27	0.00	44.96	0.000	0.007	0.000	0.018
2008	72.90	43.27	0.00	142.87	0.027	0.017	0.000	0.057
2009	106.42	40.40	42.08	174.16	0.051	0.022	0.019	0.089
2010	14.16	30.85	0.00	86.54	0.005	0.012	0.000	0.034
2011	247.58	50.03	167.45	329.80	0.089	0.021	0.057	0.126
2012	278.95	43.88	209.81	356.64	0.135	0.029	0.094	0.187
2013	226.02	42.19	155.99	292.76	0.104	0.024	0.069	0.146
2014	240.82	43.69	166.54	312.03	0.096	0.021	0.063	0.133
2015	416.05	54.93	326.52	505.22	0.133	0.023	0.098	0.172
2016	339.90	59.58	247.61	444.94	0.080	0.017	0.056	0.110
2017	532.51	66.69	419.29	643.62	0.107	0.016	0.081	0.135
2018	390.69	67.10	282.40	505.30	0.070	0.014	0.048	0.094
2019	195.96	76.42	66.96	322.20	0.029	0.012	0.010	0.051
2020	143.87	70.49	27.30	262.86	0.020	0.010	0.004	0.037
2021	817.47	89.89	672.44	968.52	0.077	0.010	0.062	0.094
2002-21	3934.80	232.94	3557.50	4341.14	0.057	0.004	0.051	0.063
2011-21	3913.69	204.10	3582.91	4245.83	0.076	0.005	0.068	0.083

Table B.3: Robustness check: Amount of purchases

Used region		50 bins				75 bins			
Excluded region		12 bins		15 bins		12 bins		15 bins	
Polynomial size		3	5	3	5	3	5	3	5
Year	2002	9.94	2.50	2.93	0.00	35.38*	0.00	38.97*	0.00
	2003	1.81	0.00	17.06	0.00	85.95*	0.00	125.10*	0.00
	2004	0.00	0.00	0.00	0.00	59.63*	0.00	116.64*	0.00
	2005	24.49	64.45	19.26	72.06	110.10*	0.00	134.36*	0.00
	2006	111.67*	68.26*	103.10*	22.95	184.47*	75.20*	200.54*	54.39
	2007	90.54*	66.12	100.39*	63.92	250.14*	1.36	308.41*	0.00
	2008	107.13*	117.86*	119.92*	98.19*	280.20*	68.78*	345.95*	72.90
	2009	162.90*	158.57*	153.91*	133.37*	281.87*	126.6*	313.36*	106.42*
	2010	78.90*	60.21	83.28*	52.69	197.05*	26.27	239.76*	14.16
	2011	280.19*	230.79*	285.76*	201.21*	404.87*	250.17*	449.40*	247.58*
	2012	299.80*	269.72*	330.42*	308.34*	360.51*	258.93*	403.00*	278.95*
	2013	246.34*	185.59*	292.27*	214.50*	365.29*	202.05*	429.54*	226.02*
	2014	262.87*	211.06*	303.24*	250.95*	375.52*	218.09*	436.01*	240.82*
	2015	476.50*	433.22*	546.64*	519.96*	589.14*	384.71*	672.15*	416.05*
	2016	433.40*	386.36*	453.08*	381.87*	580.97*	349.78*	645.43*	339.90*
	2017	555.27*	562.76*	646.94*	685.42*	656.31*	486.87*	741.74*	532.51*
	2018	433.09*	289.08*	560.23*	455.20*	570.34*	294.14*	722.01*	390.69*
	2019	413.79*	323.90*	443.05*	312.36*	535.97*	295.14*	605.66*	284.01*
	2020	439.74*	422.99*	447.11*	305.10*	530.55*	215.50*	582.12*	143.87*
	2021	986.90*	581.98*	1200.55*	600.25*	1382.87*	736.61*	1631.18*	817.47*
	2002-21	5278.86*	4466.12*	5910.10*	4953.78*	7819.99*	3804.82*	9121.98*	3934.80*
	2011-21	4751.88*	4079.64*	5507.38*	4643.54*	6347.39*	3685.73*	7316.29*	3913.69*

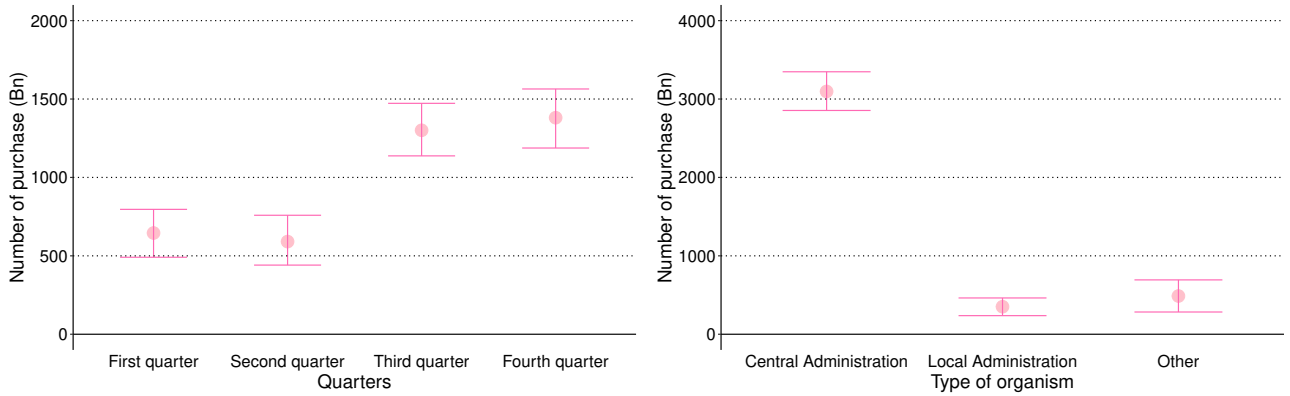
Note: The in the table means that the value of the amount of purchases is statistically different from zero, at a 95% confidence threshold.

Table B.4: Robustness check: Rate of Distortion

Used region		50 bins				75 bins			
Excluded region		12 bins		15 bins		12 bins		15 bins	
Polynomial size		3	5	3	5	3	5	3	5
Year	2002	0.025	0.006	0.007	0.000	0.120*	0.000	0.130*	0.000
	2003	0.001	0.000	0.011	0.000	0.071*	0.000	0.104*	0.000
	2004	0.000	0.000	0.000	0.000	0.045*	0.000	0.090*	0.000
	2005	0.017	0.052	0.013	0.056	0.103*	0.000	0.126*	0.000
	2006	0.073*	0.040*	0.065*	0.012	0.149*	0.045*	0.159*	0.031
	2007	0.041*	0.029	0.045*	0.027	0.160*	0.001	0.200*	0.000
	2008	0.043*	0.048*	0.048*	0.038*	0.156*	0.026*	0.196*	0.027
	2009	0.088*	0.084*	0.080*	0.067*	0.204*	0.063*	0.226*	0.051*
	2010	0.033*	0.024	0.034*	0.021	0.103*	0.010	0.125*	0.005
	2011	0.107*	0.082*	0.107*	0.068*	0.191*	0.091*	0.212*	0.089*
	2012	0.158*	0.133*	0.175*	0.157*	0.217*	0.125*	0.244*	0.135*
	2013	0.123*	0.082*	0.150*	0.097*	0.239*	0.093*	0.289*	0.104*
	2014	0.113*	0.083*	0.132*	0.102*	0.199*	0.087*	0.235*	0.096*
	2015	0.172*	0.147*	0.203*	0.187*	0.254*	0.122*	0.295*	0.133*
	2016	0.114*	0.097*	0.118*	0.093*	0.181*	0.085*	0.201*	0.080*
	2017	0.119*	0.121*	0.141*	0.154*	0.154*	0.098*	0.174*	0.107*
	2018	0.085*	0.051*	0.111*	0.085*	0.125*	0.052*	0.161*	0.070*
	2019	0.072*	0.053*	0.076*	0.050*	0.102*	0.047*	0.114*	0.045*
	2020	0.071*	0.068*	0.070*	0.045*	0.091*	0.030*	0.099*	0.020*
	2021	0.102*	0.052*	0.128*	0.053*	0.172*	0.069*	0.206*	0.077*
	2002-21	0.084*	0.068*	0.094*	0.075*	0.149*	0.055*	0.175*	0.057*
	2011-21	0.101*	0.082*	0.118*	0.094*	0.156*	0.072*	0.181*	0.076*

Note: The in the table means that the value of the rate of Distortion is statistically different from zero, at a 95% confidence threshold.

Figure B.4: Distortion by purchase time and buyer's type 2011-2022

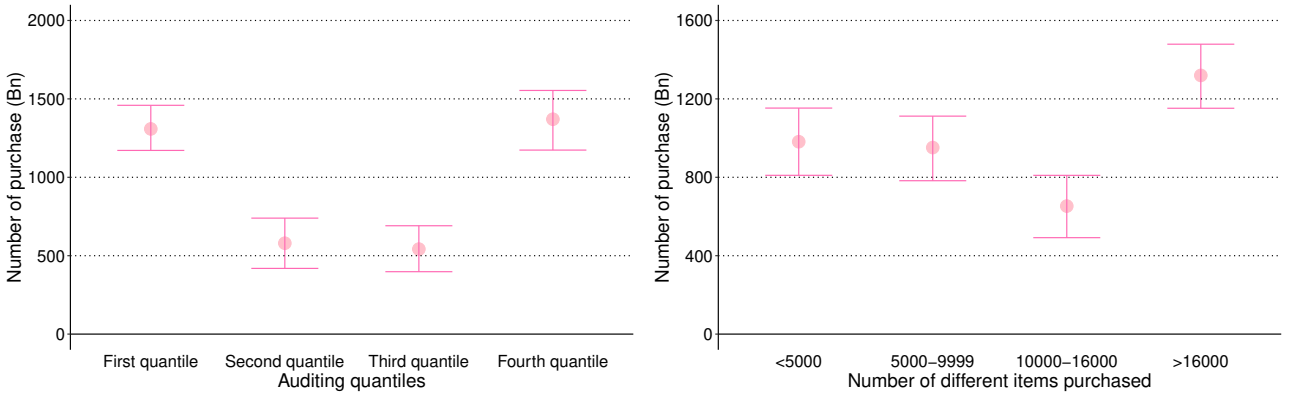


(a) Distortion by quarter in the year

(b) Distortion by type of buyer

*Note:*The left panel show the amount of distorted purchases B_n estimated by type of buyer. distorted procurement are those above the counterfactual distribution. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by type of buyer.

Figure B.5: Distortion by audit intensity and items purchased 2011-2022



(a) Distortion by auditing intensity

(b) Distortion by number of different items purchased

Note: The left panel show the amount of distorted purchases B_n estimated by the number of items bought. distorted procurement are those above the counterfactual distribution. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by the items bought.

Table B.5: Distorted purchases and procurement prices

	(1) Distortion(0.9-1)	(2) Distortion(0.9-1)	(3) Distortion(0.9-1)	(4) Distortion(0.9-1)	(5) Distortion(0.9-1)	(6) Distortion(0.9-1)	(7) Distortion(0.9-1)	(8) Distortion(0.9-1)	(9) Distortion(0.9-1)
Distortion(0.9-1)									
Seller at t-1 in Buyer	0.0298	-0.00720	0.0382*						
	(1.87)	(-0.62)	(2.27)						
Seller at t-2 in Buyer				0.0428**	0.0213	0.0488**			
				(2.92)	(1.94)	(3.13)			
Seller ever in Buyer							-0.00603	-0.0272*	0.00131
							(-0.33)	(-2.07)	(0.07)
Year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Organism fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procurement procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All buyers	No	Yes	No	No	Yes	No	No	Yes	No
All procedures	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Range	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15
Observations	55725	107293	48660	55725	107293	48660	55725	107293	48660

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	(1) Distortion(0.95-1)	(2) Distortion(0.95-1)	(3) Distortion(0.95-1)	(4) Distortion(0.95-1)	(5) Distortion(0.95-1)	(6) Distortion(0.95-1)	(7) Distortion(0.95-1)	(8) Distortion(0.95-1)	(9) Distortion(0.95-1)
Distortion(0.95-1)									
Seller at t-1 in Buyer	0.0203	-0.00571	0.0239						
	(1.13)	(-0.43)	(1.26)						
Seller at t-2 in Buyer				0.0228	0.0118	0.0277			
				(1.37)	(0.93)	(1.58)			
Seller ever in Buyer							-0.00598	-0.0277	-0.0114
							(-0.29)	(-1.82)	(-0.52)
Year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Organism fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procurement procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All buyers	No	Yes	No	No	Yes	No	No	Yes	No
All procedures	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Range	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15
Observations	55688	107233	48660	55688	107233	48660	55688	107233	48660

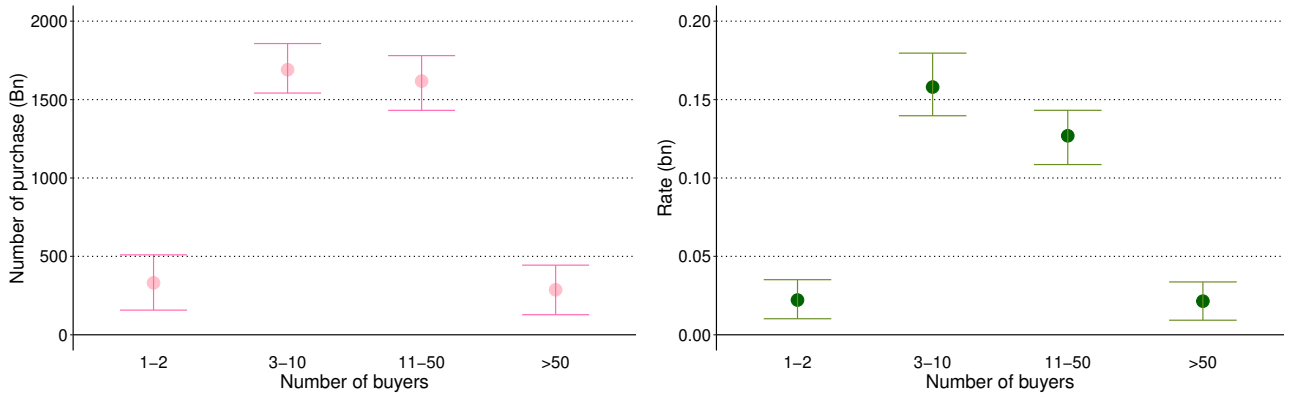
t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	(1) Distortion(0.99-1)	(2) Distortion(0.99-1)	(3) Distortion(0.99-1)	(4) Distortion(0.99-1)	(5) Distortion(0.99-1)	(6) Distortion(0.99-1)	(7) Distortion(0.99-1)	(8) Distortion(0.99-1)	(9) Distortion(0.99-1)
Distortion(0.99-1)									
Seller at t-1 in Buyer	0.0328	0.00163	0.0264						
	(1.43)	(0.09)	(1.11)						
Seller at t-2 in Buyer				0.0265	0.0111	0.0266			
				(1.26)	(0.65)	(1.22)			
Seller ever in Buyer							0.0110	-0.0165	-0.00818
							(0.42)	(-0.81)	(-0.30)
Year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Organism fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procurement procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All buyers	No	Yes	No	No	Yes	No	No	Yes	No
All procedures	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Range	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15	0.25-1.15
Observations	55462	106791	48660	55462	106791	48660	55462	106791	48660

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: These tables report estimates of the association between distorted purchases and procurement prices. The dependent variable is the standardized price. Each panel uses a different definition of distortion. All specifications include buyer and procurement procedure fixed effects. Standard errors are clustered at the buyer level.

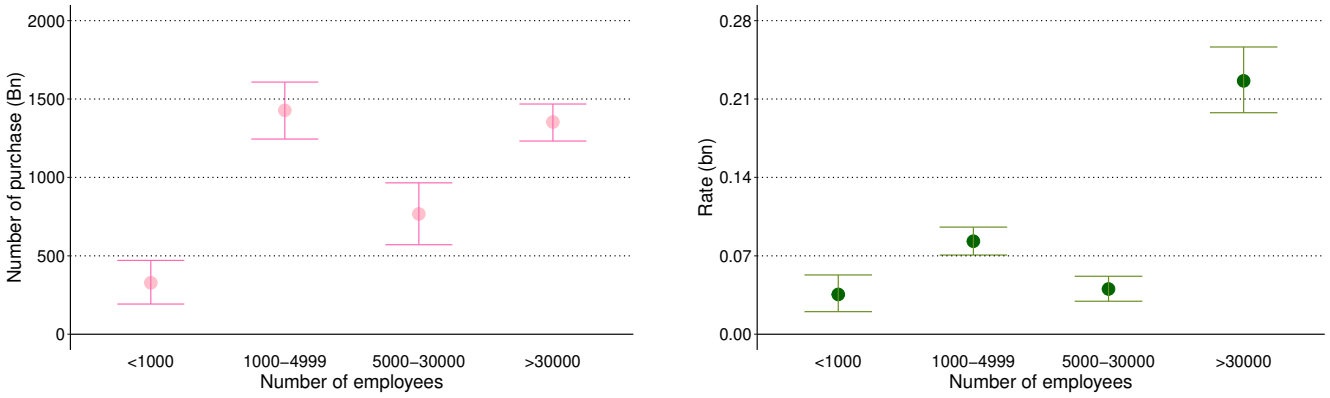
Figure B.6: Distortion by number of buyers within the organism 2011-2022



(a) distorted purchase, B_n (b) Rate of distortion, b_n

Note: The left panel show the amount of distorted purchases B_n estimated by the number of buyers within the organism. distorted procurement are those above the counterfactual distribution. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by the number of buyers within the organism.

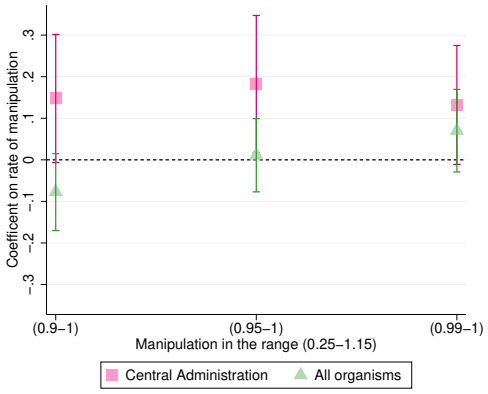
Figure B.7: Distortion by number of employees 2011-2021



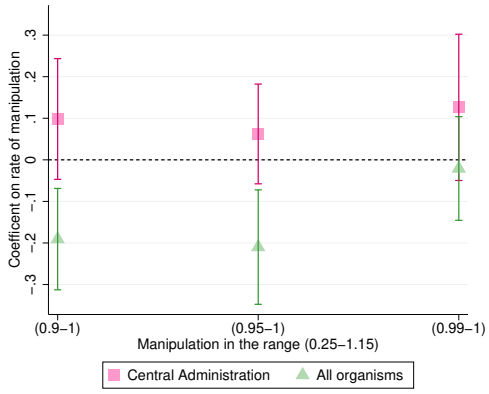
(a) distorted purchase, B_n (b) Rate of distortion, b_n

Note: The left panel show the amount of distorted purchases B_n estimated by the number of employees. distorted procurement are those above the counterfactual distribution. In Figure 3, distorted purchases are the difference between the green line (the observed number of procurement) and the pink line (the counterfactual estimated following Kleven and Waseem (2013)) in the interest area around the threshold. The right panel show the ratio b_n, the distorted purchases over the total purchases in the interest area by the number of employees.

Figure B.8: Rate of distortion persistence



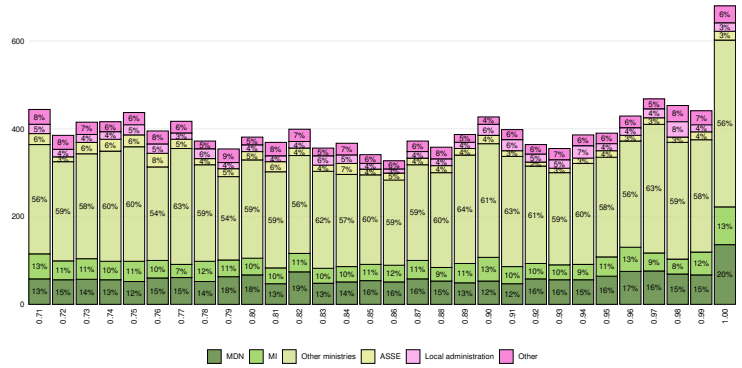
(a) Persistence in the rate of distortion



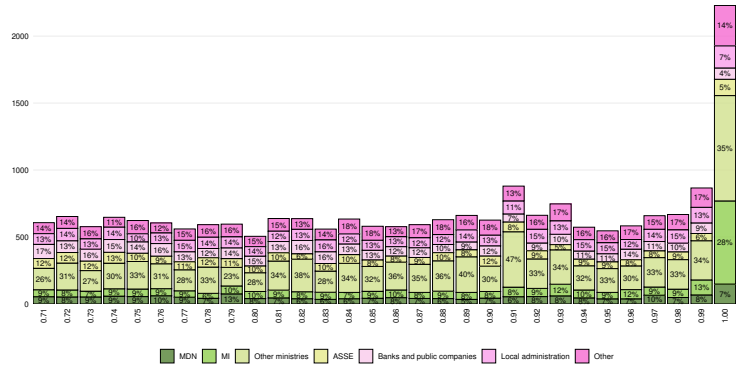
(b) Change in buyers (less stringent threshold)

Note: .

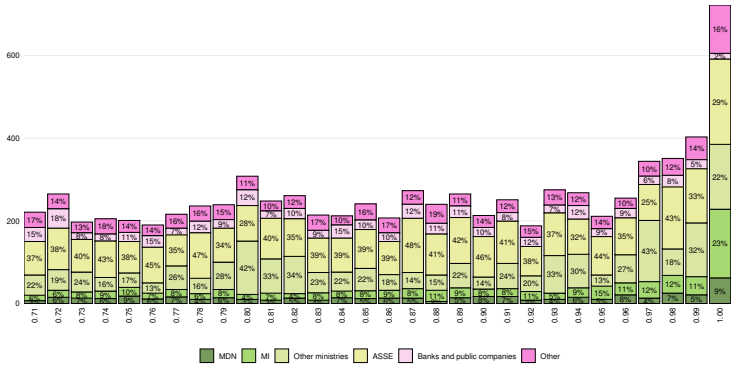
Figure B.9: Bunch buyer composition as threshold change



(a) Bunch composition January 2002- June 2012



(b) Bunch composition July 2012- July 2020



(c) Bunch composition August 2020- December 2021

Note: The graphs show the buyer participation in each of the awards bins behind the threshold. The panel a) consider those purchase done before the threshold change of July of 2012. The panel b) shows the buyer participation with 2012-2020 threshold. Finally, in panel c) there is the buyer participation with the threshold after July 2020.