Corruption and Manipulation of Public Procurement: Evidence from the Introduction of Discretionary Thresholds

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[Preliminary version]

Abstract:
We present a methodology for detecting manipulation of public procurement and evidence showing how policies that create discontinuous incentives to avoid transparent competition lead to manipulation and active waste by procurement officials. Our methodology exploits a natural experiment in which new discretionary thresholds in the anticipated value of procurements were established. Manipulations reveal through bunching of procurements below the new thresholds and affect 11% of relevant contracts. Manipulations lead to increases in the chance of allocating contracts to anonymously owned firms often related to corrupt behavior, increases in the final prices of procurements and preferential prices for anonymous contractors.

Keywords: procurement, corruption, manipulation, discretion, incentives, thresholds

JEL classification: D73, H72, K42

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I. Introduction

Corruption disrupts resource allocation all over the world. Growth and economic development are hampered by propping up of inefficient firms and allocating resources away from their socially most productive uses (Murphy, Shleifer and Vishny 1991, 1993). Corruption can be detrimental to public service provision as contracts go to firms offering the greatest incentives to public officials rather than to firms with best price-quality solutions. The extent of this waste can be substantial; in OECD countries alone 14% of public budgets are redistributed through public procurement systems (OECD 2010).

In order to increase competition and reduce waste in procurement, many European countries and also the United States use open and transparent auctions above certain legislative thresholds (Bulow and Klemperer 1996, Europe Economics 2006, Tadelis 2009). In turn, procurements below discretionary thresholds are allocated using restricted auctions where only firms selected by procurement officials can submit their bids.¹ Thresholds are thus intended to align the behavior of officials with societal interests of cost-efficient procurement and optimal contract allocation. However, if officials can use too much discretion, procurement below thresholds can provide sizeable opportunities for rent-seeking behavior and corruption.

In this paper, we use a novel methodology to provide evidence showing how these policies that create opportunities for avoiding open procurement competition lead to behavioral distortions and active waste as agents seek to game the rules. We use a natural experiment to show that procuring officials manipulate anticipated value of procurements in order to select contractors in non-transparent auctions with restricted entry. As a result, suppliers with anonymous owners, who are often related to corrupt behavior², gain preferential access to procurements and increase the price of procurements.

¹ The US Federal Acquisition Regulation (FAR), for example, has the “simplified acquisition threshold” set at contract value $150,000. Several reporting requirements do not apply below this value; the Miller Act (requiring payment and performance bonds) does not apply, etc.

² Numerous reports conclude that companies whose ultimate beneficiaries are not traceable may facilitate undesirable behavior (United Nations 1998, Transcrime 2000, OECD 2001, or FATF 2006.)
Our contribution is useful for many countries in gaining insights into how to detect manipulative behavior and active waste by public officials and ultimately save public resources. Our approach is built on the growing field of academic forensic economics, which offers a complementary view to the literature that identifies culture as a key cause of corruption (Mauro 2004, Lambsdorff 2006, Fisman and Miguel 2008, Barr and Serra 2010). Forensic economics demonstrates that other factors – such as the structure of regulation, the level of accountability or the scope of discretion of public officials – also play an integral role in determining the prevalence of corruption (see Zitzewitz (2012) for a survey in forensic economics).

This paper contributes to the agenda of forensic economics by extending the methodology previously used for estimating labor supply elasticity by Chetty, Friedman, Olsen and Pistaferri (2011) to identification of manipulation of procurement tenders. We focus on manipulation that is manifested by emergence of irregular patterns in the distribution of the anticipated value and final price of procurements. As opposed to Chetty et al., who analyze repeated cross-sectional distortions in distributions, we employ a natural experiment in which new discretionary thresholds were established. Using additional information about the characteristics of firms (e.g. about their ownership structure) and final price of procurements, we test for the negative impact of manipulations on selection of contractors and waste of public resources.

The natural policy experiment that we use originates from the Czech Republic, where the public procurement market corresponds to approximately 16 % of GDP and where cross-country comparisons indicate high levels of both bribery and favoritism in public contracting (Transparency International 2012; World Economic Forum 2011). The gist of the experiment consists of the establishment of several new statutory thresholds in the anticipated value of procurements by Czech public authorities in 2006. The new thresholds discontinuously allowed public bodies to autonomously invite at least five potential contractors to procurement tenders instead of having an obligation to run transparent auctions with open access for all potential contractors. Although this policy can potentially reduce the administrative and time costs of procurement, it has
also reduced the transparency of procurement and has created substantial opportunities for manipulation of tenders, wasteful behavior and corruption, as we show below. To investigate these adverse phenomena, we use data that are unique in many aspects — namely, they contain information about more than 46,000 procurements worth more than USD 52.2 billion and include details about public tenders and uniquely about the winning contractors and traceability of their owners.

In our analysis, we document the sudden emergence of several sharp discontinuities in the distributions of the anticipated value and final price of procurements. The discontinuities appear exactly at the points of new thresholds and only in contract-allocation procedures restricted by thresholds. Further, the proportion of contracts allocated to firms with anonymous owners, which are often related to corrupt and rent-seeking behavior in procurement, increases in the proximity of thresholds. Manipulation leads to shifts in the distribution of final prices of procurements and to an increase in the total amount paid for the relevant contracts by almost 12%.

Although we cannot rule out that some procurements were manipulated due to efficiency reasons, our results suggest that avoiding open and transparent auctions leads to waste of public resources by selecting anonymous suppliers as contractors and increasing the final price of procurements.

We demonstrate that procurement thresholds induced manipulations in 11% of relevant procurements. This finding is supported by several robustness checks, including placebo threshold and inflationary adjusted threshold. Other studies estimating the prevalence of corruption in public service provision show similar results, as it was reviewed by Svensson (2005).

In the related literature, a lot of attention has been devoted to theoretical drivers of corruption (Shleifer and Vishny 1993, 1994, Bliss and Di Tella 1997, Ades and Di Tella 1999, Acemoglu and Verdier 2000, or Burguet and Che 2004), while there are fewer empirical studies due to the scarcity of relevant data and the secretive nature of corruption. In light of these difficulties, the empirical literature has turned recently to the evaluation of corruption using policy changes (for instance, DiTella and Schargrodsky 2003, Bandiera, Prat and Valletti 2009), field experiments (Bertrand,
Djankov, Hanna and Mullainathan 2007, Olken 2007, Ferraz and Finan 2008) and examining discrepancies in large samples of administrative data (Reinikka and Svensson 2004, Fisman and Wei 2004, Olken 2006). We follow the recent literature and analyze irregularities emerging after a policy change in the Czech Republic.

No previous research was performed on the impact of procurement thresholds determining the format of contract-allocation on the corrupt behavior of procurement officials, except for the previous work leading to this paper (Palguta 2013, 2014). In a recent study, Liebman and Mahoney (2013) demonstrate the importance of procurement deadlines at the end of the fiscal year for waste and welfare losses. Spagnolo (2012) and Coviello and Mariniello (2014) analyze the impact of reduced transparency requirements and increased discretion below thresholds on economic outcomes in procurement. Several other studies have documented manipulative behavior generated by non-linear incentives at thresholds in other areas of the economy (e.g. Wolfers 2006; McCrary 2008; Saez 2010; Camacho and Conover 2011).

Very little evidence is available about the corrupt behavior of procuring officials in general. The majority of empirical studies rather focus on collusion between bidders (e.g. Porter and Zona 1993; McMillan 1991; Baldwin, Marshall and Richard 1997). Only several studies, e.g. by DiTella and Schargrodsky (2003), Bandiera et al. (2009), Hyytinen, Lundberg, and Toivanen (2007) and Goldman, Rocholl and So (2012), analyze favoritism and corruption of procurement officials. Although these studies provide valuable insights into the motivations of the officials, the incentives derived from the non-linear structure of procurement regulation are largely neglected in them.

Finally, because hiding the owners of contracting firms corresponds to concealing potential conflict of interests of actors in procurement, this study relates to the extensive literature that studies the connections of firms to state officials and representatives (for instance, Roberts, 1990; Fisman, 2001; Khwaja and Mian, 2005; Faccio, 2006; Jayachandran, 2006; Goldman, Rocholl and So, 2012). Consistently with this strand of the literature, this study demonstrates several advantages to potential

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3The authors intentionally analyze those sub-segments of procurement where technological constraints limit the scope for manipulation and therefore do not analyze the behavioral responses to thresholds.
hidden connections—for instance, firms with anonymous owners enjoy preferential access to contracts below procurement thresholds.

The rest of the paper is organized as follows. Section 2 discusses the institutional framework of Czech public procurement, the non-linear incentives introduced into it and behavioral responses that the non-linearity may stimulate. Section 3 describes the data from procurement contracts. Section 4 presents our empirical strategy for identifying manipulation of procurement contracts. Section 5 gives the results and an empirical analysis of manipulation, along with numerous robustness checks. Section 6 presents evidence that supports the hypothesis of corruption and active waste driving manipulation. Section 7 summarizes our main findings and provides policy implications.

II. Institutional Background and Non-linear Incentives

Public Procurement and Corruption in the Czech Republic

Public procurement constitutes one of the largest public spending processes in the Czech Republic. Yearly, about 13-16% of GDP (USD 31 billion in 2010) is spent on procurement of goods, construction works and services, making it the second largest procurement market among OECD countries (OECD 2010).

Czech public procurement has been criticized for favoritism, corruption and lack of effective institutional oversight. The World Economic Forum (2011) ranked the Czech Republic as low as 123rd among 142 countries in terms of the extent to which government officials show favoritism toward well-connected firms. In the Corruption Perceptions Index produced by Transparency International (2012), the Czech Republic ranked in 54th-57th position. Finally, even though two public institutions oversee Czech public procurement, one of them, the Supreme Audit Office, does not have the authority to impose sanctions but simply to issue recommendations, and the other one, the Czech Antitrust Office, has been known for its rather passive and formalistic approach (Transparency International 2009).

The prevalence of bribery and political favoritism and lack of effective institutional oversight, three factors impeding fair and efficient allocation of governmental
contracts, make the Czech Republic a good candidate for studying the nature and consequences of corruption in public procurement.

**Thresholds in the Anticipated Value of Procurements**

Several characteristics of planned procurements determine the level of accountability and autonomy for procurement agencies in the Czech institutional setting. In this research, we concentrate on the *anticipated value* of procurements as it is at the full discretion of procurement officials.

Different legislative thresholds in the anticipated value divide procurements into separate groups that differ in their mandatory requirements on transparency and open access to procurement. The rule is that the anticipated value should be set so as to approximate the anticipated obligations ensuing from the contract and it must be estimated prior to the start of the contract-awarding process. However, the procuring agencies estimate the anticipated value on their own and, as shown later, they can often set the value quite freely, so that lighter legislative restrictions apply to the targeted procurement processes.

The reform of the Czech Republic procurement code of July 2006 introduced a new type of simplified negotiating procedure into the procurement legislation and in this way introduced several new thresholds into the procurement code (see Table 1). The introduction of the new thresholds is a key factor for our identification strategy, because the new procedure is not applicable above these thresholds.

The new thresholds offered procuring officials the opportunity to free themselves from rigid rules, which otherwise regulated the transparent contract-awarding process. In particular, if the anticipated value of the procurement was set below the threshold, the officials were allowed to autonomously approach potential contractors themselves instead of being required to provide open access for any company that might want to participate in the procurement competition. Agencies therefore did not need to set lengthy deadlines for bid-submission and evaluate all the incoming bids, but could rather directly invite pre-selected companies to submit their bids. In a trade-off, the law demanded that agencies would always need to invite at least five potential suppliers so as to guarantee some degree of competition.
A major controversy arose from the fact that the decision on which bidders would be invited was left at the full discretion of the procurement agencies. In this way, the regulation created a strong opportunity and a non-linear incentive for public bodies to engage in manipulations of the anticipated values of procurement contracts.

**Sources of Manipulations and Predictions for Estimation**

In a broad sense, there appear to be three main reasons for the manipulation, where two of them imply wasteful behavior. First, procurement officials may want to manipulate the anticipated value of contracts in order to avoid transparent auctions with open access above the thresholds and save the associated time and administrative costs associated with lengthy bid-evaluation, which might be efficient and beneficial for the procuring organization. Second, the officials might want to manipulate the anticipated value of contracts to avoid the time cost for themselves, which need not be beneficial for the organization, because contractors might not be chosen optimally and/or the final prices of procurement might be higher— we follow Bandiera et. al (2009) by referring to this kind of behavior as *passive* waste. Finally, the officials might want to manipulate procurements so as to avoid auctions so that their colluded supplier can win, yielding benefits for the involved officials. The related literature refers to this kind of behavior as *active* waste.

In this paper, we directly focus on the identification of active waste that leads to intentional choice of colluded suppliers. In this case procuring organizations maximize external rent and minimize the risk of detection. For this purpose, they might need to use non-transparent auction formats, prefer firms with non-transparent ownership structure and provide them with preferential prices of procurements.

We claim that this behavior could translate into empirical changes in contractor characteristics in the proximity of procurement thresholds. This would comprise a clear sign that colluded suppliers are more likely to win. In particular, we test that winning contractors in the proximity of thresholds are more prone to hide their ultimate owners, which cannot be explained by officials’ incentives to save time or administrative costs.
Moreover, due to the active waste, the colluded suppliers should win tenders below thresholds with higher final prices of procurements. Via increased prices, the involved agents could split a larger amount of surplus from manipulated contracts. To inspect the increase in the final price, we test that manipulations lead to an overall increase in spending near the thresholds and that agencies achieve little or no reductions in the final price relatively to the anticipated value near the thresholds due to the very limited competition among bidders. We also quantify to what extent manipulations lead to distortions in the final price, which translate into some mass of contracts missing in the part of the density distribution far below the threshold, which gets shifted upwards to the part just below the threshold.

Strictly speaking, the distortions in the aggregate distribution of the final price alone do not need to necessarily imply active waste. If authorities perfectly anticipate the final price of contracts and place the anticipated value exactly below the threshold, the distortions could be justified even by efficiency reasons. Therefore, we test to what extent the distortions in the final price are connected with higher probability of anonymous firms winning procurement auctions. This would be the indication that the overall change in the distribution of final price is not driven by other sources of motivations than by active waste.

Before we proceed to the empirical part, we summarize the behavioral implications of manipulation and active waste in the following three points: (1) high-powered non-linear incentives lead to manipulations of the anticipated value and bunching of procurements below thresholds; (2) a non-transparent selection mechanism and corruption lead to negative selection of contractors among manipulated contracts, with a higher concentration of contractors with anonymous owners just below thresholds; (3) wasteful exaggeration of the procurement price translates into missing masses of procurements far below the threshold, only a small or negligible difference between final price and anticipated value among manipulated procurements and preferential prices of contracts to anonymous contractors. All three hypotheses, if supported by empirical evidence, go against the efficiency reasons behind manipulation. Nevertheless, we discuss alternative scenarios in the sixth section.
III. Data from Public Procurement Contracts

The available data on public procurement contracts includes the characteristics of all the procurements awarded in the Czech Republic from 2005 to 2010, conditionally on their procurement process being governed by the Czech Public Procurement Act. The database therefore mandatorily contains information on contracts that are larger than some minimum anticipated value (see Table 2) and does not contain data on contracts procured through legislative exemptions. Altogether, this amounts to over 46,000 procurement contracts, while the total procurement value in this investigation amounts to CZK 1,043 billion (approximately USD 52.2 billion).

The unit of observation in this study is a procurement project, although several contracts with different contractors may be procured within one project. The focus is placed on projects because the anticipated value of procurements must be estimated at the level of an entire project, rather than separately for each contract.

For each project the database includes information on the characteristics of the procured goods/services/construction works, the characteristics of the contract-awarding process, the characteristics of procuring agencies, the winning contractors and – most importantly – the anticipated value and the final contractual price of procurements.

When a winning contractor is a joint-stock company, the database includes information about the traceability of its owners. More than 15,300 contracts were awarded to joint-stock companies within our observation span, worth CZK 358.5 billion. Of this amount, CZK 20.9 billion was transferred to anonymous companies on the basis of 1,200 contracts. A total of 1,411 joint-stock companies won procurements within our observation span. 277 of them do not allow for traceability of their owners.

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4The Czech legal code specifically enables joint-stock companies to issue shares of two types: either they are nominated to concrete holders with shareholders’ names directly nominated on the shares (or in the list of shareholders) or joint-stock company can issue bearer shares, which entitle any current bearer of the shares to property rights. The share bearers are not registered anywhere and they are unknown both to the joint-stock company and to any controlling bodies. A change in ownership can be performed instantly without producing any traceable records. The owners of bearer shares usually cash in benefits from their ownership by sending legal representatives to general meetings of joint-stock companies.
Table 3 provides the summary statistics of all contracts in two observation periods: before the legislative reform of the Public Procurement Act in 2006 and afterwards. There are evident changes in the use of contract-awarding procedures after the recodification of the Public Procurement Act. More than 12% of the procurement volume shifted from the open procurement procedure to different types of less transparent negotiating procedures.

IV. Empirical Strategy for Detecting the Manipulation

We use two methods of identification for detecting the manipulation of procurements. The first method is based on the methodology of Chetty et al. (2011) and focuses on repeated cross-sectional density distributions of the anticipated value of procurements. The identification assumption, which underlies the causal inference, is that the density distributions of the anticipated value would be smooth if more restrictive tendering procedures were not prohibited above the thresholds.

The second identification method is our extension and relaxes the assumption of the smooth counterfactual density distribution by exploiting the timing of introducing new thresholds into the procurement system. We assume that the density distribution after the reform would look the same as before the reform, if the reform had not established procurement thresholds. The second method is technically only an extension of the first one, thus we start with cross-sectional analysis.

In the first method, we estimate the excess mass of contracts below a certain threshold D using a counterfactual density distribution—what the anticipated value distribution would look like if there were no ban on restrictive tendering above D.

In the first step, we plot the empirical distribution of the anticipated value of procurements in a histogram with D re-centered to zero. In the second step, a polynomial is fitted to the histogram excluding the data in a narrow window below the threshold. This means that a polynomial regression of the following form is estimated:

\[
C_j = \sum_{i=0}^{q} \beta_i \cdot (Z_j)^i + \sum_{i=1}^{0} \gamma_i \cdot 1[Z_j = i] + \varepsilon_j,
\]

where \(C_j\) is the number of procurement contracts in a histogram bin \(j\), \(Z_j\) is the anticipated value of contracts grouped in histogram bin \(j\), \(q\) is the order of the
polynomial, and \( R \) denotes the width of the excluded region below the threshold measured in the number of excluded bins below \( D \).

The estimate of the counterfactual distribution is defined as predicted values from (1) omitting the contribution of the dummy variables below the threshold:

\[
\hat{C}_j = \sum_{i=0}^{q} \hat{\beta}_i \cdot (Z_j)^i.
\]

The excess number of contracts that are located below the threshold is\(^5\):

\[
\hat{B}_N = \sum_{j=-R}^{0} C_j - \hat{C}_j = \sum_{i=-R}^{0} \hat{y}_i.
\]

Finally, we define the empirical estimate of the excess mass below the threshold relative to the average density of the counterfactual anticipated contract value distribution between \(-R\) and 0 as:

\[
\hat{b} = \frac{B_N}{\sum_{j=-R}^{0} \hat{C}_j / R}.
\]

We calculate the standard error for \( \hat{b} \) using a parametric bootstrap procedure. We draw from the estimated vector of errors \( \xi_j \) in (1) with replacement to generate a new set of counts and apply the above technique to calculate a new estimate \( \hat{b}^k \). We define the standard error of \( \hat{b} \) as the standard deviation of the distribution of \( \hat{b}^k \)’s.

The second identification method incorporates time dimension into the econometric model. This method relaxes the assumption of a smooth density distribution of the anticipated contract value and assumes that the shape of the density distribution after the 2006 reform would look the same as before it.

The estimation again proceeds in two steps. We first plot all the annual histograms of the anticipated value with thresholds re-centered to zero. In the second step, we regress the number of contracts in bin \( j \) and time \( t \), denoted as \( C_{jt} \), on an interaction term between an indicator for contracts located in the excluded region below threshold and indicator for the validity of the 2006 reform (that occurred in time

\(^{5}\)This calculation would overestimate \( B_N \) because it does not satisfy the constraint that the area under the counterfactual distribution must equal the area under the empirical distribution. To take this aspect into account, we follow Chetty et al. (2011) and correct the counterfactual distribution above the threshold so that the integration constraint is satisfied.
denoted as $T$). We include in our model a set of fixed effects for histogram bins in which contracts would be located and annual fixed effects, which are supposed to capture the time trend. The econometric model can be formally expressed as follows:

$$C_{jt} = \alpha_j + \alpha_t + \sum_{i=-R}^{0} \gamma_i \cdot 1[Z_j = i] \cdot 1[t > T] + \epsilon_{jt}$$

The coefficients of interest $\hat{\gamma}_i$, $i \in [1, R]$, represent our estimates of the excess mass of contracts in particular bins of the excluded region below the threshold. We estimate the regressions using Poisson conditional fixed-effects quasi-maximum likelihood (QML). This estimator has several desirable properties, including 1) consistency of the coefficient estimates independently of any assumption on the conditional variance as long as the mean is correctly specified (Wooldridge, 1997) and 2) consistency of the standard errors even if the data generating process is not Poisson

V. Empirical Analysis of Manipulation Detection

We start with cross-sectional analysis and plot the empirical distribution of the anticipated value of procurements for all the construction contracts procured in the Czech Republic after the 2006 procurement reform up to the end of our observation span in 2010 (Figure 1). The contracts are grouped into CZK 250,000 bins (-14,000,000 to -13,750,000, -13,750,000 to -13,500,000, etc.) on the re-centered anticipated value variable (the threshold is re-centered to zero).

Figure 1 shows that there is a spike below the simplified negotiations threshold in the otherwise declining anticipated value distribution. The solid area beneath the empirical distribution shows the counterfactual density $\{\hat{C}_j\}$ predicted using (1) with a seventh-degree polynomial (q=7) and a window of CZK 750,000 located just below the threshold (R=3). With these parameters, we estimate $b = 9.35$ – the excess mass below the threshold is 935 % of the average height of the counterfactual distribution within CZK 750,000 below the threshold. The first column of Table 4 presents these results. The standard error associated with our estimate of $b$ is 1.80. The null hypothesis that

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6The estimation is implemented in STATA with the xtpqml procedure written by T. Simcoe and is available at http://people.bu.edu/tsimcoe/code/xtpqml.txt

7The qualitative results are not sensitive to changes in q or R, nor are they sensitive to specifications accounting for specific focal points located within the anticipated value distribution (for example, located at substantial round figures within the distribution).
there is no excess mass at the threshold relative to the counterfactual distribution is rejected with a t-statistic of 5.207.

Using the same methodology, we find statistically significant evidence of manipulations of the anticipated values of goods and services contracts. Figure 2 presents the visual inspection of these results, while the second and third columns of Table 4 summarize the results quantitatively. The estimated excess mass at threshold for goods contracts is 200% of the average height of the counterfactual distribution. The estimated excess mass at the threshold for services is 303% of the average counterfactual distribution height. Based on a quick back-of-the-envelope calculation, Tables 3 and 4 suggest that the manipulations affect 11% of all contracts procured through the simplified negotiating procedure after July 2006.

The identification assumption of the smooth counterfactual density distribution can be relaxed by exploiting the timing of the introduction of new thresholds into the procurement legislation. Figure 3 displays the distribution of the anticipated value in each year from 2005-2010 for all construction works. In the subfigures it is clear that the first appearance of bunching appears just a few months after the introduction of the simplified negotiating threshold into the procurement system. In the subfigures, the excess mass of contracts clings very closely to the legislative threshold.

The annual estimates of discontinuities for all types of the main subject are shown in Table 5. The procurement reform and the first emergence of discontinuities coincide perfectly for goods and services contracts. For construction works, the discontinuity can be statistically detected after a six month delay.

Explanations for the delay for construction works can vary. On one hand, the procuring authorities might have discovered the proceedings of simplified negotiations only gradually through a learning and experience-sharing process. Even though the simplified negotiations were less complex than other procedures, the procuring bodies might have needed some time to discern the level of oversight by controlling

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8 Table 4 indicates 1,364 contracts excessively massed below thresholds, while Table 3 shows that altogether 12,372 procurements were allocated using simplified negotiations after July 2006.

9 Due to space constraints, we omit figures showing the annual distributions for goods and services contracts. The estimates of the excess masses for these contracts are listed in Table 5.
authorities over the new procedure, especially over potential manipulation of the anticipated value. This reason would not, however, explain the difference in timing of the first emergence of bunching across different types of contracts.

A simpler explanation may be that the procurement process itself requires some non-trivial amount of time, which varies for different types of contracts. Since the new law was passed in July 2006, the authorities may not have procured enough construction contracts (as opposed to smaller and simpler goods and services contracts) in the last two quarters of 2006 for anticipated value manipulations to become statistically significant before 2007.

We further continue with quantifying the excess mass using Poisson conditional fixed effects. Table 6 shows the results of estimating (5), which incorporates time into our model, with CZK 250,000 wide histogram bins and CZK 750,000 wide excluded region below the threshold (R=3). Using these parameters, we estimate that the number of contracts in the last bin below the threshold increased after the 2006 reform by 156%, 113%, and 182% for construction works, goods, and services contracts, respectively. The null hypotheses of no manipulation of procurement in these bins were rejected with z-statistics of 24.79, 13.30, and 16.20. The results are qualitatively in line with the estimates from the cross-sectional analysis presented in Table 5 and qualitatively not sensitive to omitting years 2008-2010 from the analysis.

Robustness Checks

We provide alternative approaches for manipulation detection and robustness analysis. In particular, we test whether the procurements cluster at placebo thresholds or at inflationary adjusted thresholds. Finally, we use the alternative density test described by McCrary (2008) to test for clustering of procurements at thresholds.

Discontinuities at Placebo Thresholds

Contracts could bunch at the point of the threshold also in procurement procedures which are unrestricted by the threshold. This would weaken the hypothesis that it is primarily the threshold that stimulates manipulation. Figure 4 therefore estimates the excess mass of contracts at the point of the simplified negotiations threshold in three
procedures which are unrestricted by the threshold. Namely, we inspect contracts allocated using open auctions, restricted auctions and a negotiating procedure without prior public notice.

Figure 4 shows that a significant mass of contracts bunched below the “placebo” threshold cannot be statistically discerned in any of the three inspected procedures. Table 7 summarizes the quantitative results. The “placebo tests” confirm that the primary source of excess masses below the threshold is based on the overuse of simplified negotiations, i.e. the procedure restricted by procurement thresholds.

**Does Contract Bunching Follow Inflation or Does it Cling to Thresholds?**

One could still conjecture that at the time of the procurement reform a change occurred in the governmental orders for projects that were worth approximately the same value as the procurement threshold. Such a change in governmental needs would have brought about a disproportionate representation of projects beneath the threshold even in the absence of any manipulation. However, one would then expect that the spike in the anticipated value density distribution would shift with inflation over time.

In Figure 5 we consider the period from 2007 to 2010, during which the simplified negotiations threshold for construction works declined in real terms. Noting that the excess mass was located at the negotiations threshold in 2007, the figure shows two possibilities for its location in 2010: the 2010 threshold and the 2007 threshold adjusted for inflation in the construction industry.

Figure 5 shows that the excess mass clearly clings to the 2010 threshold rather than following inflation. The procurement threshold is therefore more important for contract bunching than specific governmental needs.

**Alternative Density Discontinuity Test**

We apply McCrary’s (2008) density test in order to provide an alternative test of contract bunching. The test consists of an extension of the local linear density estimator from Cheng, Fan and Marron (1997) and is particularly useful in applications where a discontinuous density is itself the object of interest. In a practical sense, the
test is implemented as a Wald test of the null hypothesis that there is no discontinuity at threshold D.

Figure 6 presents the estimate of the density function of the anticipated value of public construction contracts, applying identical methodology to McCrary (2008). The bandwidth and bin size were selected subjectively after using an automatic procedure\textsuperscript{10}. The figure uses a bin size of \(w=250,000\) and a bandwidth of \(h=2,000,000\). The automatic procedure would select a bin size of \(w=191,313\) and a bandwidth of \(h = 4,749,168\). The automatic procedure would over-smooth the histogram.\textsuperscript{11}

Figure 6 strongly suggests that the underlying density function is discontinuous at the threshold for simplified negotiations. Importantly, the histogram reveals that this is not the result of under-smoothing. Both the histogram and the local linear smoother indicate that contracts within hundreds of thousands of CZK of the threshold are much more likely to be procured below the threshold than above it.

Table 8 presents the log discontinuities estimated using McCrary's (2008) local linear regressions along with the simulated standard errors.\textsuperscript{12} The estimated log discontinuities are -329.1%, -45.7%, and -80.1% for construction works, goods, and services, respectively. All estimates are highly statistically significant with t-ratios of -13.53, -4.4 and -10.09 for construction works, goods, and services, respectively. These results affirm the robustness of our prior analysis of contract bunching.

VI. Evidence for Wasteful Behavior Driving Manipulation

Despite the robust evidence for manipulations of the anticipated value, the results presented so far still do not refute the hypothesis that public officials could manipulate the anticipated value simply to avoid the costs associated with more transparent and open procurement above the thresholds.

\textsuperscript{10} Pagan and Ullah (1999) and Deaton (1997) point out the effectiveness of subjective bandwidth choice.

\textsuperscript{11} McCrary (2008) states that, for a fixed bandwidth, the estimator is robust to different choices of bin size, provided that \(h/w>10\), which is the case in this specification.

\textsuperscript{12} We follow Horowitz (2001), Hall (1992) and McCrary (2008) and, when estimating the standard error, we under-smooth the local linear estimator by choosing a half bandwidth with respect to the reference bandwidth. The cited authors recommend this procedure in order to reduce the bias associated with a bandwidth which minimizes the asymptotic mean square error.
As outlined in the discussion of the sources of manipulation in the second section, in order to assess the potential of active waste driving manipulation, we examine the discontinuous change in the allocation of contracts to non-transparent anonymous contractors near to thresholds. We focus on contractors that conceal their ownership, because anonymity of ownership poses a threat to the efficiency and fairness of procurement— it conceals the potential conflict of interest of agents who are simultaneously procurement officials and stakeholders in anonymous companies. The situation could lead agents to yield to their private interests and secure preferential treatment for allied companies. We therefore claim that, if manipulation has negative consequences for the actual choices of contractors, we should observe a higher concentration of firms with concealed owners among manipulated contracts.

We also examine how manipulations translate to distortions in the final price of procurements in a manner inconsistent with manipulation being driven by efficiency considerations. In particular, we test that the increase in the amount paid for contracts below the threshold is not compensated by a decrease in the amount paid for contracts above the threshold and thus that there is an increase in the total amount of money paid to contractors as a result of the threshold. Further, to rule out other potential factors driving changes in the final price, we test the extent to which the increase in the final price is related to the allocation of contracts to firms with anonymous ownership. Finally, we discuss alternative scenarios that could lead to our empirical findings.

**Preferential Access of Anonymously Owned Contractors to Procurements**

In this part, we start with the empirical analysis of anonymous contactors and their access to procurements in the construction industry. We focus particularly on construction works, because their capital-intensity and resulting market structure make construction the only segment with a sufficiently large share of joint-stock companies for which we have information about the traceability of the firms’ owners.

Figure 7 examines the access of anonymous contractors to procurements in the proximity of thresholds. In particular, Figure 7 contrasts the share of construction works awarded to anonymous firms in two periods: before and after the 2006 reform.
We use kernel-weighted local polynomial smoothers and 1 million CZK bandwidths on either side of the threshold to plot Figure 7. The figure clearly indicates that, after the 2006 reform, contracts just below threshold were allocated in a much larger proportion to firms that had their ultimate owners concealed and this way could have potentially facilitated rent-extraction in procurement.

We also inspect the preferential access of anonymous firms to contracts in a regression framework, applying a similar methodology to that leading to equation (5). For each contract we create a binary variable for whether contract was awarded to an anonymous contractor or not. We regress this measure of access to contracts on a variable that captures the interaction between contracts located just below thresholds and the validity of the 2006 reform. Our specification also includes annual fixed effects and fixed effects for histogram bins in which contracts are located. We estimate the regressions using probit and a linear probability model (LPM), respectively, with standard errors clustered at the histogram bin level.

Table 9 presents the results of this estimation and supports the findings presented in Figure 7. In particular, Table 9 suggests that anticipated value manipulations distort the contractor choice by showing that the conditional probability that a winning contractor just below threshold is anonymous increased after the 2006 reform by approximately 8 percentage points. These results are significant at the 1% level.

**Distortions in the Distribution of the Final Price**

In this part, we continue by showing that manipulations of anticipated value translate to distortions in the final price of procurements. In order to test for presence of distortions, we use a similar approach as we used in detecting manipulation of the anticipated value, leading to equation (1). We, however, incorporate two important distinctions: 1) in the first step, we plot the empirical histograms of the final value of procurements; 2) we fit a polynomial to the histograms while excluding data in a region symmetric around the threshold. In this way we can test that the increase in the amount paid for contracts below D is not compensated by a decrease in the amount paid for contracts above D.
Figure 8 presents the empirical distributions of the final price of procurements around the thresholds for construction works in 2005 and 2007, i.e. the years before and after the 2006 reform. Subfigures show that, after the introduction of the threshold, a spike emerged below the procurement threshold in otherwise declining final price distribution. The counterfactual distribution shown beneath the empirical one is predicted with a seventh-degree polynomial (q=7) and a window of CZK 750,000 excluded around the threshold. We find that the discontinuity in the final price is statistically significant only in the period after the procurement reform.

Table 10 repeats the same exercise for all types of the main subject of contracts. We estimate excess masses of contracts at thresholds that are 766%, 252%, and 309% of the average densities of the counterfactual distributions of the final price between -R and R for construction works, goods, and services, respectively. The standard errors associated with our estimates are 1.19, 0.18, and 0.21, respectively, which allows us to reject the null hypotheses of no distortions at the thresholds. Our qualitative results are not sensitive to choices of q or R. The estimates imply a wasteful presence of excess mass of contracts worth 11.5 billion CZK, which corresponds to 11.7% of the value of contracts procured in simplified negotiations after 2006. However, this calculation is valid only under the assumption that procurements have not been shifted upwards from far below the threshold.

To address the issue of shifts in the distribution of the final price, we contrast the pre- and post-reform cumulative density functions (CDFs) of the final price, adjusted for inflation as shown in Figure 9. Here, we observe that a significant mass of contracts in 2007 moved towards the threshold from far below the threshold (left subfigure). In later years, the distribution of the final price remained unchanged and distorted (right subfigure). A series of two-group proportion z-tests validate these findings as they reject the null hypotheses of equal proportions of contracts procured below various points in the 2005 and 2007 CDFs, up to the price of 17 million CZK. The z-tests suggest

13 Due to space constraints, we omit similar figures for goods and services. We present the corresponding results in Table 10.
that the 2007 CDF is significantly below the 2005 CDF for small contracts and significantly above it for contracts larger than 19.5 million CZK.

Further, we present evidence that the increase in the final price of procurement is directly related to the preferential treatment of anonymous firms. This finding rules out the efficiency reasons as a potential explanation for shifts in the distribution of the final price. Table 11 shows the OLS estimates of a regression where the difference between the final price and anticipated value (as % of the anticipated value) is regressed on the interaction term between the indicator for contracts located just below the threshold (750,000 CZK below or less) and the indicator for anonymous firms. The regression includes histogram bin fixed effects, annual fixed effects and a dummy variable for anonymous contractors. Using the post-2006 sample, we estimate a 6.7 percentage point increase in the final price of tenders that were awarded to anonymous contractors just below the thresholds. The estimate is significant at the 1% level.

Finally, Figure 10 shows that distortions are associated with an overall drop in the difference between the final price and anticipated value of procurements. In particular, Figure 10 shows that simplified negotiations (relatively to open auctions) lead to a much higher final price of procurement that increases as the contract prices approach the threshold. This suggests that competition between bidders is limited in manipulated procurements and that manipulation leads to wasting of public resources.

**Alternative Explanations**

Finally, we address the remaining alternative scenarios that could explain the bunching of contracts below thresholds. For example, one might conjecture that efficiency considerations could drive procurement officials to change the content of tenders and place them just below the threshold and thus save time and administrative costs. Alternatively, procurement officials could manipulate contracts so that they had more discretion in eliminating firms with poor past performance from the competition (Calzolari and Spagnolo 2009). These explanations are, however, inconsistent with the observed increase in allocation and preferential prices of contracts to anonymous firms, which tend to be rather related to rent-seeking and corruption.
Finally, it still might be argued that some contracts were undercut in their anticipated value due to efficiency considerations and thus placed just below the threshold. This could lead to small or negligible difference between the final price and the anticipated value in procurements below the threshold. Nevertheless, we have shown in Figure 9 that a significant mass of contracts originates from far below the threshold, which goes against the hypothesis of solely undercutting the anticipated value.

VII. Concluding Remarks

In this study we have demonstrated a method for detecting and quantifying manipulation of procurement contracts using the example of the Czech public procurement system. The incentive for officials to indulge in manipulation was created by non-linearity in the procurement system. Below certain thresholds decreed by the procurement law, the procurement agencies had the sole discretion to invite any five contractors of their choice to the bidding process, excluding all others. Such opportunities created high-powered non-linear incentives for corruption and (generally) active waste. We demonstrate that manipulation led to an increase in the probability of awarding contracts to firms with concealed owners by 8 percentage points and a further increase in the final price of procurements by 7 percentage points.

Considering all the evidence is important when postulating policy recommendations. For example, should procurement officials be allowed to choose among procurement procedures more freely? This study shows that the underlying reason for excessively massing contracts below thresholds seems to lie in private benefits from manipulation for procurement officials. However, these private benefits incur costs for society in terms of elevated prices and suboptimal choice of contractors. In general, there is misalignment between the preferences of officials and those of society. The optimal delegation literature (e.g. Alonso and Matouschek 2008) advises calling for stricter rules and external controls in such cases. In the spirit of Holmstrom and Milgrom (1991), it might also be optimal to strip procurement officials of the discretion to select potential contractors and rather leave them with the option of including past performance indicators among the bid-evaluation criteria.
This analysis has a substantial advantage in that it provides controlling bodies with a new tool for analyzing fairness and manipulation in procurement competition. We illustrated the scope for manipulation using the case of the Czech Republic, but many other countries regulate their procurement by similar thresholds, although with different changes in discretion at thresholds. For example, the Italian procurement system instructs agencies to invite 10 more potential contractors to tenders above the threshold, which could also lead to manipulation of the anticipated value. Given the often limited resources of controlling bodies, we suggest that it may be most cost-efficient to use our methodology to find the extent of manipulation and further test to what extent it has adverse consequences on the price of procurement and selection of winners.

The overall effect of increasing the efficiency of procurement may be manifold: both through the direct effect on savings and optimization of the choice of contractors and indirectly through increased competitiveness and trust in the fairness of the procurement process. The procurement environment would surely benefit from identification of its weak points.

References


Di Tella, Rafael, and Ernesto Schargrodsky, “The Role of Wages and Auditing during a Crackdown on Corruption in the City of Buenos Aires,” Journal of Law and Economics, 46 (2003), 269-92

Europe Economics, Evaluation of Public Procurement Directives (European Commission, DG Internal Market, 2006).


### TABLE 1

Procurement Thresholds for Simplified Negotiating Procedure (in thousands of CZK)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goods and Services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- National Procurers</td>
<td>N/A</td>
<td>4,290*</td>
<td>4,290</td>
<td>3,782</td>
<td>3,782</td>
<td>3,236</td>
</tr>
<tr>
<td>- Regional Bodies</td>
<td>N/A</td>
<td>6,607*</td>
<td>6,607</td>
<td>5,857</td>
<td>5,857</td>
<td>4,997</td>
</tr>
<tr>
<td><strong>Construction Works</strong></td>
<td>N/A</td>
<td>20,000*</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Table 1 shows the annual procurement thresholds for simplified negotiations by the main object of procurements and the type of contract-awarding agency (in thousands of CZK). Thresholds for simplified negotiations determine the scope of discretion of public officials in inviting suppliers of their choice. Thresholds also restrict entry of bidders and determine the overall transparency of the contract-awarding process. *Simplified negotiation thresholds were introduced on July 1st, 2006. Source: Consolidated text of act no. 137/2006 Coll. on Public Contracts.

### TABLE 2

Minimum Anticipated Value for Collecting Data about Procurements (in thousands of CZK)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goods and Services</strong></td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Construction Works</strong></td>
<td>2,000</td>
<td>6,000*</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
</tr>
</tbody>
</table>

Table 2 shows the annual minimum anticipated values of contracts above which information about procurements is mandatorily collected and published online (in thousands of CZK). Procurements below the minimum are not included in official data collection. Only general rules regarding efficiency and fair treatment of contractors pertain to these contracts. *The change in the minimum value is valid from July 1st, 2006. Source: Consolidated texts of act no. 40/2004 Coll. on Public Procurement and no. 137/2006 Coll. on Public Contracts.
### TABLE 3
Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contracts</td>
<td>(%)</td>
</tr>
<tr>
<td>By main object:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Goods</td>
<td>1,510</td>
<td>21.99</td>
</tr>
<tr>
<td>- Services</td>
<td>1,110</td>
<td>16.17</td>
</tr>
<tr>
<td>- Construction works</td>
<td>4,246</td>
<td>61.84</td>
</tr>
<tr>
<td>By contract-awarding procedure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Open</td>
<td>5,314</td>
<td>77.40</td>
</tr>
<tr>
<td>- Restricted</td>
<td>1,552</td>
<td>22.60</td>
</tr>
<tr>
<td>- Simplified Negotiations or</td>
<td>N/A**</td>
<td>N/A**</td>
</tr>
<tr>
<td>Negotiations with Prior Public Notice*</td>
<td>N/A**</td>
<td>N/A**</td>
</tr>
<tr>
<td>- Negotiations w/out Prior Public Notice</td>
<td>N/A**</td>
<td>N/A**</td>
</tr>
<tr>
<td>By procuring agency type:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- National Procurers</td>
<td>3,408</td>
<td>49.64</td>
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<tr>
<td>- Regional Public Bodies</td>
<td>3,458</td>
<td>50.36</td>
</tr>
</tbody>
</table>

Table 3 includes summary statistics for contracts procured under both the old and the new Public Procurement Act, which has been in place since July 2006. Statistics are provided both by the number of procurement projects and by the procurement volume (in billion CZK; 20 CZK ≈ 1 USD). *Contract-awarding procedures of simplified negotiations and negotiations with prior public notice are presented in a single category due to the nature of the evidence of records of procurement contracts. **N/A mark indicates the non-applicability of a statistic for a given observation period. Source: Own calculations.
TABLE 4
Polynomial Regression Estimates of Excess Mass below the Threshold

<table>
<thead>
<tr>
<th>Construction Works</th>
<th>Goods</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\hat{b}$</td>
<td>9.352***</td>
<td>1.996***</td>
</tr>
<tr>
<td>[1.850]</td>
<td>[0.236]</td>
<td>[0.275]</td>
</tr>
<tr>
<td>$\hat{\beta}_N$</td>
<td>581</td>
<td>282</td>
</tr>
<tr>
<td>N</td>
<td>8,830</td>
<td>5,228</td>
</tr>
</tbody>
</table>

Table 4 shows the estimates of excess masses of contracts bunched by their anticipated value below the procurement threshold for simplified negotiations, estimated using equation (1). A seventh-degree polynomial and CZK 750,000 excluded window located just below the threshold were used to predict the counterfactual density of the anticipated value of procurements. $\hat{\beta}_N$ denotes the estimated excess number of contracts below the threshold, and $\hat{b}$ denotes the excess mass of contracts relative to the average density at the threshold. Standard errors are presented in brackets. ***Estimates significant at the 1% level. Source: Own calculations.

TABLE 5
Estimated Excess Mass below the Threshold by Year and Main Object

<table>
<thead>
<tr>
<th>Year</th>
<th>Construction Works</th>
<th>Goods</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excess Mass Estimates</td>
<td>SE</td>
<td>Excess Mass Estimates</td>
</tr>
<tr>
<td>2005</td>
<td>2.861</td>
<td>[1.902]</td>
<td>0.410</td>
</tr>
<tr>
<td>2006</td>
<td>2.628</td>
<td>[1.891]</td>
<td>1.635***</td>
</tr>
<tr>
<td>2007</td>
<td>12.100***</td>
<td>[2.697]</td>
<td>1.389***</td>
</tr>
<tr>
<td>2008</td>
<td>8.965***</td>
<td>[1.651]</td>
<td>1.799***</td>
</tr>
<tr>
<td>2009</td>
<td>11.190***</td>
<td>[2.504]</td>
<td>1.901***</td>
</tr>
<tr>
<td>2010</td>
<td>8.954***</td>
<td>[1.990]</td>
<td>2.362***</td>
</tr>
</tbody>
</table>

Table 5 shows the estimates of excess masses of contracts bunched by their anticipated value below the thresholds for simplified negotiations, estimated using equation (1). Legislative reform that established new thresholds into the procurement legislation occurred in midyear 2006. A seventh-degree polynomial and CZK 750,000 excluded window located just below the threshold were used to predict the counterfactual density of the anticipated value of procurements. Estimates represent the estimated excess mass of contracts relative to the average density at thresholds. Standard errors are presented in brackets. ***Estimates significant at the 1% level. Source: Own calculations.
Table 6 reports the estimates of excess masses of contracts bunched by their anticipated value below thresholds estimated using equation (5) and Poisson conditional fixed-effects QML. The basic unit of observation in all the regressions is a histogram bin from empirical annual distributions of the anticipated value of contracts. The number of contracts awarded in each bin and year serves as the outcome variable that is regressed on the interaction between the indicator for bins located just below the thresholds (R=3) and indicator for validity of the 2006 reform. All regressions include histogram bin fixed effects and annual fixed effects. Coefficient estimates are interpreted as \((\exp(\hat{\beta})-1)\ast 100\) percentage change. Robust standard errors, clustered at the histogram bin level, are presented in brackets, *** p<0.01, ** p<0.05, * p<0.1. Source: Own calculations.

Table 7 shows the estimates of excess masses of contracts for three procurement procedures, unrestricted by procurement thresholds. Excess masses are estimated at “placebo” thresholds, which are located at points in the anticipated value distribution where a simplified negotiations threshold would apply. The main specification (1) is employed in the estimation. Only construction work contracts from 2006 - 2010 are considered in the estimation. A seventh-degree polynomial and CZK 750,000 window located just below the “placebo” thresholds were used to predict the counterfactual density of the anticipated value of procurements. Estimates represent the estimated excess masses of contracts relative to the average density at the threshold. Standard errors are presented in brackets. Estimates are not significantly different from zero at the standard significance levels. Source: Own calculations.
TABLE 8
Log Density Discontinuity Estimates

<table>
<thead>
<tr>
<th></th>
<th>Construction Works</th>
<th>Goods</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{\theta} )</td>
<td>-3.291***</td>
<td>-0.457***</td>
<td>-0.801***</td>
</tr>
<tr>
<td>[0.243]</td>
<td>[0.104]</td>
<td>[0.079]</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>9,067</td>
<td>6,869</td>
<td>8,518</td>
</tr>
</tbody>
</table>

Table 8 presents the log estimates of discontinuity in the density of the anticipated value. Estimates were obtained using a local linear density estimator proposed by McCrary (2008). Simulated standard errors are presented in brackets, *** p<0.01, ** p<0.05, * p<0.1. Source: Own calculations.

TABLE 9
The Impact of Manipulation on Contractor Choice

<table>
<thead>
<tr>
<th>Outcome variable:</th>
<th>Linear Probability Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator that Contractor is Anonymously Owned</td>
<td>Probit</td>
</tr>
<tr>
<td>Contracts in Bins Just below D x 2006 Reform</td>
<td>[0.009]</td>
</tr>
<tr>
<td>Histogram Bin Fixed Effects</td>
<td>YES</td>
</tr>
<tr>
<td>Year Fixed Effects</td>
<td>YES</td>
</tr>
<tr>
<td>(Pseudo) R^2</td>
<td>0.05</td>
</tr>
<tr>
<td>N</td>
<td>4,265</td>
</tr>
</tbody>
</table>

Table 9 reports the results of estimation of (5) using probit and a linear probability model (LPM), where the dependent variable is replaced by a binary variable for whether a contractor is an anonymous joint-stock company. Only procurements of construction works are considered. The outcome variable is regressed on the interaction term between an indicator for contracts located just below thresholds (750,000 CZK below or less) and indicator for the validity of the 2006 reform. All regressions include histogram bin fixed effects and year fixed effects. Estimates from the LPM multiplied by 100 can be interpreted as percentage point change. The results from probit are the estimated marginal effects. Robust standard errors, clustered at the bin level, are presented in brackets, *** p<0.01, ** p<0.05, * p<0.1. Source: Own calculations.
Table 10 shows the estimates of excess masses of contracts obtained using equation (1) with the distinction that bunching is estimated using the final prices of procurements and the excluded window is symmetric around the procurement threshold for simplified negotiations. A seventh-degree polynomial and a CZK 750,000 window located around the threshold were used in the estimation. $\hat{b}_N$ denotes the estimated excess number of contracts around the threshold and $\hat{b}$ denotes the excess mass of contracts relative to the average density at the threshold. Standard errors are presented in brackets. ***Estimates significant at the 1% level. Source: Own calculations.

Table 11 shows the estimates of an OLS regression, where the difference between the final price and anticipated value of contracts (calculated in % of the anticipated value) serves as the outcome variable. The outcome is regressed on an interaction term between the indicator for contracts located just below procurement threshold (750,000 CZK below or less) and indicator for contractors being anonymous. The regression includes fixed effects for histogram bins in which the procurement would be located according to its anticipated value, annual fixed effects and a dummy variable for contractors being anonymous. The estimates multiplied by 100 can be interpreted as percentage point changes. Robust standard errors, clustered at the bin level, are presented in brackets, *** p<0.01, ** p<0.05, * p<0.1. Source: Own calculations.
FIGURE 1
Anticipated Value Density Distribution around the Procurement Threshold

Figure 1 shows the distribution of the anticipated value of procurements around the threshold for simplified negotiations (re-centered to 0) for construction works. The series shown in bars is a histogram of the anticipated value of construction works, relative to the threshold. Each bar shows the number of observations in CZK 250,000 bins. The solid distribution beneath the empirical distribution is a seventh-degree polynomial fitted to the empirical distribution, excluding points CZK 750,000 or less below the threshold, as described in equation (1). The series is trimmed from above by an arbitrary threshold of CZK 40 million. The estimated excess mass at the threshold is 935% of the average height of the counterfactual distribution. Source: Own calculations.
Figures 2 shows the distributions of the anticipated value of procurements around the procurement thresholds for simplified negotiations (re-centered to 0). Panel (a) shows procurements of goods and panel (b) services procurements. The series shown in bars are histograms of the anticipated values of procurements, relative to the thresholds. Each bar shows the number of observations in CZK 250,000 bins. The solid distributions beneath empirical distributions are seventh-degree polynomials fitted to empirical distributions excluding points CZK 750,000 or less below the threshold, as described by equation (1). The series are trimmed from above by an arbitrary threshold of CZK 40 million. The estimated excess masses at the threshold are 200% and 303% of the average height of the counterfactual distributions beneath for goods, and services contracts, respectively. Source: Own calculations.
These figures show the distributions of the anticipated values of procurements around the thresholds for construction works in each year from 2005 to 2010. The thresholds are re-centered to 0. Series shown in bars are histograms of the anticipated value of procurements relative to the thresholds. Each bar shows the number of observations in CZK 250,000 bins. The solid distributions beneath empirical distributions are seventh-degree polynomials fitted to empirical distributions, excluding points CZK 750,000 or less below the threshold, as described in equation (1). The series are trimmed from above by an arbitrary threshold of CZK 40 million. The estimated excess masses at the thresholds are presented in the first column of Table 5. Source: Own calculations.
FIGURE 4
Anticipated Value Distribution by Type of Procurement Procedure

Figure 4 shows the distributions of the anticipated value of procurements around the “placebo” thresholds (demarcated by the vertical line at 0) in three contract-awarding procedures, which are unrestricted by procurement thresholds. Only construction contracts from 2006 to 2010 are considered in the figure. “Placebo” thresholds are located at points where simplified negotiation thresholds would be located. Series shown in bars are histograms of the anticipated value of procurements relative to the “placebo” threshold. Each bar shows the number of observations in CZK 250,000 bins. The solid distributions beneath the empirical distributions are seventh-degree polynomials fitted to empirical distributions, excluding points CZK 750,000 or less below the threshold, as described in equation (1). The top subfigure shows the series for contracts procured through an open procurement procedure. The middle subfigure depicts the series for contracts procured through a restricted procurement procedure. The bottom subfigure considers contracts procured through a negotiating procedure without prior public notice. The series are trimmed from above by an arbitrary threshold of CZK 40 million. The estimated excess masses at the “placebo” thresholds are presented in Table 7. Source: Own calculations.
Distinguishing Thresholds in Public Procurement from Inflation

Figure 5 replicates the distribution of the anticipated value of procurements from Figure 3(f), zooming in around the threshold for simplified negotiations. The location of the threshold in 2010 is marked with a solid line. The dashed line shows the level of the 2007 threshold adjusted for inflation in the Czech construction industry. Source: Own calculations.

Density of Anticipated Value Estimated Using McCrary’s Local Linear Estimator

Figure 6 shows the density distribution of the anticipated value around the threshold for construction works (demarcated by a vertical line at 0). Only contracts from 2006 to 2010 are considered in the figure. The scatter-plot is a histogram of the anticipated value of procurements in CZK 250,000 bins. The solid line beneath the empirical distribution is a local linear smoother fitted to the empirical distribution estimated as described in McCrary (2008). The figure shows the confidence interval of the estimator. The estimated log density discontinuity estimates are presented in Table 8. Source: Own calculations.
FIGURE 7
Share of Construction Contracts Awarded to Anonymous Firms, by Year

Figure 7 shows the share of construction tenders awarded to contractors with anonymous owners in the proximity of threshold (demarcated by the vertical line at 0). The examined statistic is plotted for two periods: before and after the 2006 reform. The share of contracts awarded to anonymous contractors is calculated using kernel-weighted local polynomial smoothers and CZK 1 million bandwidths, separately on either side of the threshold. Source: Own calculations.

FIGURE 8
Density Distribution of the Final Price of Procurements around the Threshold, by Years

The subfigures in Figure 8 show the distributions of the final price of procurements around the thresholds for construction works in a) 2005 and b) 2007, i.e. before and after the 2006 reform. Thresholds are re-centered to 0. Series shown in bars are histograms of the final price of procurements relative to the threshold. Each bar shows the number of observations in CZK 250,000 bins. The solid distributions beneath the empirical distributions are seventh-degree polynomials fitted to the empirical distributions, excluding points CZK 750,000 or less symmetrically around the threshold. The series are trimmed from above by an arbitrary threshold of CZK 40 million. Source: Own calculations.
Figure 9 shows the cumulative density functions of the final price of procurements for 2005 and 2007 in the left subfigure and for 2007 and 2008 in the right subfigure, around the procurement thresholds for construction works. The 2005 and 2008 prices are adjusted for inflation in the Czech construction industry to match the 2007 prices. Contracts worth more than CZK 40 million were disregarded from the subfigures. Source: Own calculations.

Figure 10 shows the percentage difference between the final price and anticipated value of procurements (as % of anticipated value) in the neighborhood of the simplified negotiations threshold (demarcated by a vertical line at CZK 20 mil.). The figure shows the price difference for two procurement procedures: the black solid line shows the open procedure; the black dashed line shows simplified negotiations. The grey regions show the 95% confidence intervals for the average differences. The price difference is calculated using kernel-weighted local polynomial smoothers and CZK 1 million bandwidths, separately on either side of the threshold. Only procurement construction works contracts from 2006 to 2010 are considered. Source: Own calculations.