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Political donations, public procurement and government efficiency

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ABSTRACT

Public procurement markets are worth 10–15% of global GDP. Recent empirical evidence suggests that firms' political donations can induce important distortions in the allocation of public procurement contracts. In this article, we employ a non-parametric efficiency model to study the implications of such distortions for the regional governments' efficiency. Using a unique dataset covering the Czech regions over the 2007–2017 period, we find that the efficiency of public good provision is lower when a larger share of public procurement contracts is awarded to firms donating to the party in power ('party donors') – even when we account for quality differences in public goods provision. We link the dependence on politically connected firms to the institutional design of the procurement allocation process (i.e. the use of less restrictive and less open allocation procedures), which helps explaining the mechanics behind the observed decrease in efficiency.

1. Introduction

As general government spending constitutes on average about 43% of GDP in OECD countries (OECD, 2019), cost-effective management of the public sector's resources is a major concern. Nonetheless, a growing body of empirical work provides evidence of important allocative distortions in a key part of public spending: i.e. public procurement. Firms with political connections are found to be significantly more successful in obtaining procurement contracts compared to firms lacking such connections (Goldman, Rocholl, & So, 2013; Baltrunaite, 2020; Schoenherr, 2019; Titl & Geys, 2019).[1] Although public procurement accounts for about 12% of GDP and roughly 25% of general government spending in OECD countries (OECD, 2016; OECD, 2019), the potential economic impact of such distortions remains poorly understood and is rarely quantified.

We address this research gap by exploring the impact of politically connected firms on the cost efficiency of regional governments. Our key argument is that favouritism towards politically connected firms in public procurement allocations undermines public sector efficiency. This negative relation arises because those favoured by political connections might not be the most competitive or cost-effective firms, and provide fewer or worse services compared to those failing to get contracts due to a lack of political ties.[2] Since the 'best' firm thus is not necessarily allocated a given contract, the ensuing misallocation of resources would be expected to induce provision at excessive cost compared to the situation where contracts are allocated optimally.

We empirically test this proposition by linking the cost efficiency of Czech regional governments to their observed level of favouritism towards politically connected firms in public procurement allocations. This is feasible due to a unique new dataset covering firms' political donations, public procurement contracts and

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[1] We here use the term 'political connections' to refer to any link – whether through personal ties, board memberships or financial transactions (including ownership and donations) – between politicians and private-sector firms. In our empirical analysis, we focus on ties established through donations by firms to political parties. We therefore employ the terms donating firms and connected firms interchangeably throughout the remainder of the article.

[2] Such a negative link between political connections and – the cost of – service provision can easily be formalised in a selection model with positive substitutability between political connections and firm quality.

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regions' public good provision over the period 2007–2017. Clearly, firms' political donations are not unique to the Czech Republic, and are allowed also in several other countries such as Austria, Brazil (up to 2016), Germany, Italy, Lithuania (up to 2012), the Netherlands, Switzerland, the United Kingdom or the United States (albeit indirectly via Political Action Committees; PACs). Yet, a key advantage of our Czech setting is that *all* donations are fully disclosed, which provides a unique level of access to the information required to perform our analysis. Furthermore, the Czech Republic is comparable in terms of perceived institutional quality to bigger economies such as Israel, Italy, Spain or South Korea (Transparency International, 2019). These elements suggest the broader applicability of our analysis to other countries where (direct) corporate donations are allowed and institutional quality is equivalent.

Our empirical analysis proceeds in two stages. In a first step, we employ a non-parametric robust conditional efficiency model (Daraio & Simar, 2005; Daraio & Simar, 2007) to measure regional government efficiency. Exploiting the difference between cost-efficiency models that do and do not account for regions' dependency on politically connected firms in public procurement, we examine how public sector efficiency is affected by political favouritism. The results support the theoretical proposition that a larger share of public procurement contracts awarded by the Czech regions to politically connected suppliers – operationalized via firms' donations to political parties – is associated with reduced cost efficiency in regional public good provision. This negative relation arises despite the fact that we account for potential quality differences, which is important since auxiliary analyses indicate that quality tends to be lower when reliance on politically connected suppliers is higher. It also persists under various model specifications and robustness checks.

Then, in a second step, we shed light on the mechanics behind the preferential allocation of procurement contracts, which helps explain when and why some regions display higher dependence on politically connected suppliers. We thereby focus on the idea that distortions in public procurement are affected by the design of the relevant decision-making rules. In our Czech setting, some procedures involve procurement tender announcements that allow bids by any firm (i.e. 'open' procedures), while other procedures are characterised by more restricted access (e.g., public authorities inviting only a limited number of firms to submit bids). Similarly, when the estimated value of the contract remains under certain thresholds, procuring authorities can exercise greater discretionary power in the contract allocation process (more details below). We argue that restrictions to open competition or increases in authorities' discretionary power create opportunities for the preferential treatment of connected firms (which, in turn, may be expected to undermine the efficiency of public good provision). Our results support this proposition. We show that more extensive use of less open procurement allocation procedures is associated with higher shares of procurement contracts allocated to party donors. Similarly, we find that higher discretion is associated with an increase in politically connected suppliers.[3]

Taken together, these findings not only have implications for the design of procurement allocation processes, but also highlight the relevance of our methodological approach for oversight bodies in the public sector.[4] Moreover, our analysis contributes to three main strands of literature. The first analyses the level and determinants of public sector efficiency [for a review, see] (Narbón-Perpiñá & De Witte, 2018; Narbón-Perpiñá & De Witte, 2018). A wide range of potential drivers of the observed variation in efficiency across jurisdictions has been brought forward including, for instance, government accountability (Hauner & Kyobe, 2010), political competition (Ashworth, Geys, Heyndels, & Wille, 2014; Sørensen, 2014), corruption (Méon & Weill, 2010), and the presence of direct democratic citizen initiatives (Asatryan & De Witte, 2015). Although some work has been done on the relationship between corruption and the efficiency of private-sector firms [e.g.,] (DalBó & Rossi, 2007), the link between political favouritism and public sector efficiency has not previously been addressed.

The second literature studies the link between procurement procedures or auction formats and the outcome of procurement processes. This literature shows that some auction designs are more prone to allocative distortions due to favouritism (Palguta & Pertold, 2017; Decarolis et al., 2020), while also highlighting that the final outcomes of procurement processes are affected by who is allocated a contract. Coviello, Guglielmo, and Spagnolo (2018), for instance, observe better procurement outcomes for firms winning contracts repeatedly. Similarly, Calvo, Cui, and Serpa (2019) find that operational oversight by procurement officers increases cost overruns and delivery delays when contracts are allocated to less experienced suppliers. Importantly, neither strand of this literature examines the implications of these observed effects for broader economic outcomes such as public sector efficiency. Finally, a third relevant literature investigates the implications of (various types of) political connections for firms, communities and individuals. This literature indicates, for instance, that political ties benefit firms in a number of ways including stock market valuation, return on investment, access to credit and funding, and so on (Acemoglu, Johnson, Kermani, Kwak, & Mitton, 2016; Baer, Miles, & Moran, 1999; Cingano & Pinotti, 2013; Fisman, 2001; Khwaja & Mian, 2005). Political connections have also been shown to affect individuals' access to welfare transfers (Han & Gao, 2019). Still, political connections across levels of government – e.g., through partisan ties – appear less influential for public spending allocations (Karim & Noy, 2020). To the best of our knowledge, the role of firms' political connections for public sector efficiency has not been studied in this rapidly developing literature.

The next section discusses the institutional setting in the Czech Republic and the data employed in our analysis. Section 3 presentsa non-technical description of the methodology for computing conditional efficiency scores and assessing the influence of politically connected suppliers on the efficiency of public good provision. Section 4 summarizes our main findings. Finally, in Section 5, we provide a concluding discussion and some avenues for further research.

2. Institutional setting and data

2.1. Institutional setting

Our analysis focuses on the Czech regional governments, which were devised in 1997 (Act No. 347/1997 Coll.) and have been functioning since January 2000. There are 13 regions (plus the capital of Prague, which constitutes its own region) that have considerable competences in economic policies including transport, education, health care and regional development (Hooghe et al., 2016). Political power within each region is concentrated in the Regional Council (''Zastupitelstvo kraje''; henceforth 'Council') and the Board of Councillors (''Rada kraje''; henceforth 'Board'). The Council is the legislative body of a region, and is elected every four years using a system of proportional representation. The Board is the executive body of a region, and its members are appointed by – and selected

[3] These findings are consistent with recent work by Baltrunaite, Giorgiantonio, Mocetti, and Orlando (2021), and also with studies showing that contracts awarded under discretionary procedures are more often won by firms investigated for corruption (Decarolis, Fisman, Pinotti, & Vannutelli, 2020) or by anonymously owned companies (Palguta & Pertold, 2017).

[4] To facilitate the use of our methodological tools, the R code is available upon request.

among the councillers of – the parties holding a majority in the Council. Both public bodies are chaired by the *Hejtman*, which is a position equivalent to a US state Governor.

The Czech Republic provides two critical advantages for our analysis. First, although the general framework for public procurement is established in national legislation (Act No. 137/2006 Coll. on Government Procurement), local policy-makers have significant influence on the procurement allocation process – and the civil servants administering this process. This is crucial if we want to quantify the efficiency implications of politically driven distortions in public procurement. In practice, this influence first of all works through contracting authorities' ability to (mis) use the detailed prerequisites set out in the legislative framework – such as imposing rigid technical requirements or requiring very specific certificates. Such constraints reduce the number of firms that qualify for a contract, and can guide the process in the direction of a preferred firm. Furthermore, contracting authorities often are free to set the (weights given to) evaluation criteria. They can use this flexibility to award procurement contracts to firms performing exceptionally well on one specific criterion (e.g., a fine due by the firm in case of delay), even though their overall bid may not otherwise have been the most beneficial.

Second, direct corporate donations to political parties are allowed in the Czech Republic and parties have to disclose full lists of donors and amounts. Since parties that do not comply can be fined and lose part of their operational allowance from the government, they are incentivized to adhere to this regulation and existing evidence suggests that all do so.[5] As such, we are able to observe *all* party donations, which account for up to 33% of the budget of big parliamentary parties in the studied period. This provides a unique opportunity to operationalize politically connected suppliers based on firms' donations to the party in power (Titl & Geys, 2019). We thereby consider the main party in power to be the one that holds the Hejtman position, since this makes it the most powerful party in the regional Council and Board. This also implies that our definition of political connections accounts for changes in the party in power over time. That is, exploiting the three regional elections within our sample period, we operationalize firms' donations as establishing a political connection *only if* they are given to the party in power in a given region at a given point in time. Table A1 in the Appendix presents the distribution of Hejtmans across parties and time in the four legislative periods of relevance to our analysis.

2.2. Data

We exploit a balanced region-level panel dataset covering the period from 2007 to 2017. With 13 regions, our dataset thus consists of 143 observations. Three sets of data are necessary to empirically assess the propositions set out in the introduction.

First, to measure public sector efficiency, we need information on the inputs and outputs in regional governments' production process. As we are interested in the efficiency implications of distortions in the procurement process, we use regional expenditures through procurement contracts per capita as our central input (see Panel I of Table 1). We adjust this for inflation since an increase in price levels over time could boost inputs for a given level of output (implying a mechanical decline in efficiency scores over time). The mean yearly expenditure on procurement contracts was approximately 1,552 CZK per inhabitant in 2017 prices (circa $67). This includes expenditures by the regions themselves as well as expenditures by region-owned enterprises (which administer substantial levels of procurement spending especially in healthcare). Since the Czech regions allocate approximately 76% of their expenditures on education (i.e. schools and other educational facilities), health and social care, and infrastructure (i.e. roads and rail transport), we focus on outputs in these three key service domains.[6] Overall, we have 18 indicators for outputs across our three policy areas, which closely follow the choice of output indicators in previous literature [see, for example,] (Geys, Heinemann, & Kalb, 2010; Asatryan & De Witte, 2015; D'Inverno & De Witte, 2020). All output indicators are expressed in per capita terms and – as described below – we adjust them for the quality of public good provision. The latter is important to avoid our inferences being affected by changes in quality due to higher/lower reliance on political connections (which we will assess in our analysis). Panels II and III of Table 1 provide summary statistics for the quality-adjusted output variables and quality indicators, respectively. Summary statistics of raw output variables are in Appendix Table A2. First, consider the policy area education. Czech regions are responsible for maintaining kindergartens, primary, and secondary school education. Our data cover the numbers of schools (of all three types), teachers as well as students. Although pupils' knowledge and skills are usually viewed as the final outcomes, regions must transform monetary inputs into teachers and school buildings (as intermediates) to provide education services (i.e. final outputs). Hence, we use three 'intermediate' output indicators [number of students, teachers, and schools; for a similar approach, see] (Geys et al., 2010). We rely on PISA scores per region over time as a measure of education quality, and adjust all output indicators by the coefficient expressing how much worse the observation (region-year) at hand performs compared to the best performing region in the particular year. For instance, imagine a region A with an average PISA score of 446 in 2006, while the best-performing region in 2006 achieved an average of 525. Each education output indicator in region A in 2006 would then be adjusted by a coefficient 0.85 (since this region performs at 85% of the best region in that year).[7] The quality adjusted output indicators show that the average value of "Nr. of teachers in secondary school" is approximately 3.87. This means that there were 3.87 secondary school teachers per 1,000 inhabitants on average, adjusted for the quality of the region with the best education outcomes as measured by the PISA test.

With respect to healthcare services, we use the number of hospitals and other medical institutes as well as the number beds and doctors as healthcare output indicators [for a similar choice of outputs, see] (Asatryan & De Witte, 2015). To account for quality differences in healthcare, we use information on the number of deaths per capita caused by cancer or heart attack (obtained from the Czech Statistical Office). Since it is an inverse measure, we identify the region with the lowest number of deaths in a given year as the best performing benchmark. If region A records 0.0025 relevant deaths in 2007 compared to a minimum value of 0.002 in the best performing region, all outputs in region A are quality-adjusted using a factor 0.8.

With respect to infrastructure, we exploit that regions take care of roads of class 2 and 3. Hence, we use the length of such roads obtained from the Czech Statistical Office to measure output in this policy area. We add the length of railways – likewise obtained from

[5] We naturally cannot observe other possibly illegal payments by firms to parties. This implies that any observed efficiency implications in our analysis should be viewed as arising independent of such corruptive practices.

[6] According to the Czech statistical office, about 70% of secondary schools are region-run. Similarly, the Czech regions (in) directly own medical facilities that account for roughly two thirds of beds in all healthcare facilities. Finally, Czech regions own and take care of all regional and local roads (roads of class 2 and 3; Act No. 13/1997 Coll. on Roads Parliament of the Czech Republic, 1997), and order rail transport from railway companies for the provision of local and regional transport services.

[7] The PISA data were extracted from the reports by the Czech school inspection (https://www.csicr.cz/). The PISA tests take place every three years, so we use scores from 2006, 2009, 2012, and 2015. We apply the last available year for each time point in our dataset (i.e. we use 2006 data also for 2007 and 2008).

Table 1
Summary statistics

Statistic	N	Mean	St. Dev.	Min	Max
Panel I: Input					
Spending on public procurement	143	1,552.28	1,499.29	57.75	11,503.27
Panel II: Output indicators					
Nr. of kindergartens	143	0.479	0.075	0.342	0.608
Nr. of teachers in kindergartens	143	2.417	0.282	1.874	2.910
Nr. of children in kindergartens	143	30.717	3.327	24.539	36.749
Nr. of primary schools	143	0.407	0.059	0.300	0.517
Nr. of teachers in primary schools	143	5.569	0.336	4.637	6.436
Nr. of students in primary schools	143	77.788	5.198	64.911	90.440
Nr. of secondary schools	143	0.124	0.017	0.092	0.171
Nr. of teachers in secondary schools	143	3.871	0.501	2.569	4.862
Nr. of students in secondary schools	143	44.829	6.671	28.352	58.749
Nr. of doctors	143	3.566	0.517	2.279	5.072
Nr. of other med. workers	143	8.431	1.093	5.297	10.830
Nr. of hospitals	143	0.015	0.003	0.011	0.021
Nr. of beds hospitals	143	4.778	0.608	3.406	6.730
Nr. of spec. medical institutes	143	0.013	0.005	0.006	0.025
Nr. of beds in medical institutes	143	1.788	0.840	0.461	4.324
Roads class 2 in kms	143	1.034	0.863	0.081	3.186
Roads class 3 in kms	143	2.356	1.711	0.191	5.999
Length railways in kms	143	0.623	0.394	0.068	1.542
Panel III: Quality indicators					
PISA test scores	143	495.524	21.483	442	534
Deaths	143	0.003	0.0003	0.002	0.004
Traffic accidents	143	0.009	0.004	0.003	0.020
Panel IV: Independent variable					
Dependency	143	2.159	7.919	0.000	72.521
Panel V: Environmental variables					
Revenue per capita	143	16.840	1.998	13.190	22.576
Youth population	143	0.149	0.007	0.138	0.175
Elderly population	143	0.168	0.018	0.130	0.207

Notes: Dataset covers years 2007 to 2017. Spending is in CZK (21.5 CZK is equivalent to approximately 1$; the exchange rate is from January 2021). Education output indicators are adjusted for quality using average PISA scores in each region. Healthcare output indicators are adjusted using the number of deaths caused by cancer or heart attack per capita in each region-year as proxy for quality. Infrastructure output indicators are adjusted using the number of accidents per capita in each region-year. Summary statistics of raw, uncorrected output variables are in Appendix Table OA.3. "Dependency" is defined as the combined value of contracts supplied by politically connected firms over the combined value of all contracts supplied to region *i* in year *t*. Regional government revenues per capita are expressed in CZK in 2017 prices. The shares of young (under 15) and elderly (over 65) residents are relative to the total population. *Source*: Authors' elaboration based on the Czech Statistical Office and the Czech school inspection reports.

the Czech Statistical Office – as regions also buy rail transport services (see above). To take into account the quality of roads, we use the number of accidents per kilometer of roads. As this is again an inverse measure of quality, we proceed analogically to the approach set out above.

Second, to assess the role of firms' political connections on procurement allocations, we require information about both firms' party donations and public procurement contracts. As mentioned in the previous section, the Czech institutional setting allows us to observe *all* party donations. Interestingly, while only 1.1% of all Czech firms donate to political parties, 12.9% of donating firms supply procurement contracts [see also] (Titl & Geys, 2019).[8] The data on political donations include all firms' donations to all (six) political parties that were in power in the period 2007–2017. The average donation in the studied period was 144,681 CZK ($5,878), the maximum donation 20,000,000 CZK ($800,000) and the median donation 20,000 CZK ($800). We have obtained this data from a website maintained by Econlab, z.s. (a Czech NGO). We also have access to information on *all* public procurement contracts above a relatively limited threshold.[9] The available data include, among other aspects, the details of the winner of the contract, the allocation procedure and criteria, the decision date, and the value of the contract. Crucially, the data on firm donations and public procurement allocations can be linked via unique firm identifiers. As such, we can calculate for each region *i* in year *t* the share of the value of public procurement contracts awarded by a region to firms that donated to the party in power, which will be our central independent variable (*Dependency*):

$$Dependency_{it} = \frac{value\ of\ contracts\ supplied\ to\ region\ i\ by\ connected\ firms\ in\ year\ t}{value\ of\ all\ contracts\ supplied\ to\ region\ i\ in\ year\ t} \tag{1}$$

Note that the size of donations is not taken into account in our operationalization. We only label contracts as either delivered by politically connected firms (those donating to the party in power in a given year) or delivered by other firms. Summary statistics on the *Dependency* measure are provided in Panel IV of Table 1. On average, 2.2% of the total value of procurement contracts in region *i* in year *t* is allocated to politically connected firms, with a standard deviation of 7.9%. In Fig. 1, we plot how the value of *Dependency* evolves over time and across regions. This indicates substantial variation across time and space, which we can exploit in our analysis. Moreover, shocks to dependency are found to be largely transitory, do not appear to be clustered only in election years, and do not appear equally across regions in election years.

[8] This is consistent with the common observation across countries that "a large number of firms and groups avoid campaign giving" (Ansolabehere, de Figueiredo, & Snyder, 2003). For instance, in Lithuania – which reports very precise statistics regarding the share of donating firms – approximately 1.4% of firms donate to political parties (Baltrunaite, 2020; Commission, 2013).

[9] The threshold is set by Act No. 137/2006 Coll. on Government Procurement, and differs depending on the type of contract. It is 2,000,000 CZK (excluding VAT; circa $80,000) for public service contracts, 6,000,000 CZK (excluding VAT; circa $240,000) for public works.

[10] In an input-oriented model, the efficiency score reflects how much more input(s) are used for a given level of output(s).

[11] The Czech regions cannot change tax rates, i.e., the input is fixed.

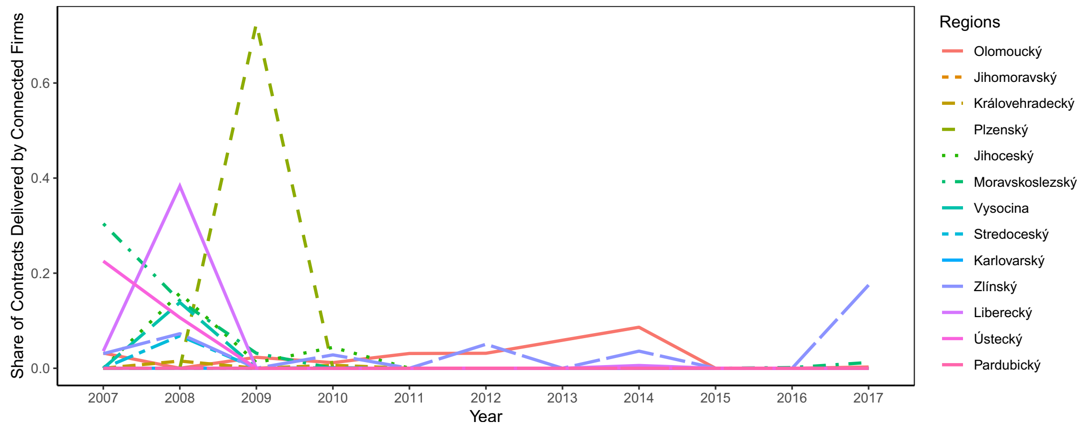

Fig. 1. Dependency over time and across regions (Notes: *Dependency* is defined as the share of public procurement contracts supplied by politically connected firms for each region and each year.).

This is important since it suggests that a substantial share of the variation in our main independent variable is not linked to elections (which mitigates any concerns that election shocks drive our results; we return to this issue below.)

Finally, panel V of Table 1 includes summary statistics for several environmental variables: i.e. *Revenues per capita*, *Share of young residents* (under the age of 16) and *Share of elderly* (65 years or older). These are important to control for different economic and social conditions in the different regions.

3. Methodology

3.1. A non-parametric efficiency model

We define efficiency as a measure of the ability to transform input(s) into desired output(s). In our setting, this is the ability to transform the total public procurement spending (one input) into the provision of public goods in the policy areas of education, healthcare, and infrastructure (outputs).

To estimate the efficiency of the Czech regional public sector, we rely on a non-parametric efficiency model rooted in the Free Disposal Hull methodology [FDH;] (Deprins, Simar, & Tulkens, 1984). As is common in public sector applications, we measure efficiency in an output-oriented way. In such a model, the efficiency score reflects the shortfall (relative to the best practice) in output (s) for given input.[10] This is preferred in public sector applications, because the public sector has usually a given level of input (tax revenue[11]) and it produces as much as public good as possible as politicians desire to get reelected. The efficiency estimates range between 0 and 1, where a value of 0.8 can be interpreted as a region performing at 80% of its potential (i.e. it is inefficient – 20% below its potential maximal output(s)). Given the multidimensional outputs, it is unclear how to ex-ante assign weights to these outputs. To accommodate this issue, the FDH model relies on a linear programming problem which is formulated to endogenously assign weights to each output in such a way that the 'efficiency' estimate is maximized for each evaluated observation. This implies that most (least) weight is given to outputs where the evaluated observation is performing better (worse) than other observations.

The FDH methodology has a number of attractive properties for our purposes. First, it is fully non-parametric, such that no functional form (e.g., Cobb-Douglas, Translog, ...) has to be assumed to model the relationship between the input and outputs. In the absence of reliable information on the functional form, this flexibility avoids a specification bias leading to biased estimates (Yatchew, 1998). Second, efficiency models rooted in FDH do not require price information. This is very useful in public sector settings since researchers often lack information on the output prices – as we do as well (Narbón-Perpiñá & De Witte, 2018). Finally, the FDH model can straightforwardly be extended to accommodate for outlying observations (i.e. making the efficiency estimates more robust to outliers; so-called 'robust' model) as well as to control for environmental factors that might influence the ability of producing the public good such as the share of elderly or the mountainous character of the region (so-called 'conditional' model). The resulting 'robust conditional efficiency model' (Daraio & Simar, 2007; De & Kortelainen, 2013) – discussed in detail in the next section – is ideal to analyse the relationship between the efficiency estimates and the political donations.

3.2. Robust conditional efficiency

A potential disadvantage of the traditional FDH model is that outlying observations fully determine the best-practice benchmark, and thereby, the obtained efficiency scores. To overcome this issue, we follow Cazals, Florens, and Simar (2002) and use 'robust FDH' model. This is done by repeatedly (B times) drawing m observations from the original full sample and assessing the efficiency against this subset. An efficiency score is then obtained by taking the average of the B bootstrapped samples. As any outlying observation will not necessarily be included in the sample in each draw, the influence of outliers is mitigated. Moreover, the final efficiency score – which is the average across all iterations – is less sensitive to systematic selection effects because the benchmark regions may change across iterations. It should be noted, however, that as the evaluated observation is not necessarily drawn in each of the B subsamples, the efficiency score is not necessarily bounded at one anymore. Efficiency scores larger than one are known as super-efficient observations, and suggest that the evaluated observation is more efficient than the average m observations they are benchmarked with. In our case, the sample size m is set to 40. The value of m is chosen following Daraio and Simar, 2005 by searching for the lowest m such that the number of super-efficient observations is stable.

This adjustment of the baseline FDH methodology still ignores the fact that regions with similar characteristics may be better reference points for each other than totally different regions (Banker & Morey, 1986). For instance, mountainous regions may be better

[10] In an input-oriented model, the efficiency score reflects how much more input(s) are used for a given level of output(s).

[11] The Czech regions cannot change tax rates, i.e., the input is fixed.

compared to other mountainous regions rather than, say, coastal regions. The influence of such environmental factors can be captured by making one more extension to the model. Rather than drawing the subsamples of size m randomly – as suggested thus far – they can be drawn with a probability determined by a Kernel function around relevant environmental characteristics (z). Hence, similar observations in terms of the environmental characteristics z are drawn with a higher probability than other observations. Then, as before, we can compute B efficiency scores for each region and define the final scores as the mean value – known as the 'robust conditional FDH estimator' (Daraio & Simar, 2005; Daraio & Simar, 2007). This is the approach we use in our analysis.

Finally, since we are mainly interested in how firms' donations to the party in power are associated with the efficiency of public good provision, we must evaluate the direction of the correlation of this factor with the efficiency scores calculated above. We thereto apply a non-parametric bootstrap procedure previously used in De and Geys (2011),e and Kortelainen (2013) and Asatryan and De Witte (2015). The impact of environmental factors is then retrieved by regressing the ratio of conditional and unconditional efficiency scores against the vector of environmental factors in a local linear regression. The procedure is as follows. First, we estimate the efficiency scores with controls for environmental factors (conditional efficiency scores) and without controls for environmental factors (unconditional efficiency scores). Second, we run local linear regression of the ratio of conditional scores on unconditional scores on environmental variables z (*Dependency* is the main variable of our interest). If the environmental characteristics z is positively correlated with the ratio, then z acts as an extra input that is freely available and makes the production easier. In this case, we say that the particular z variable is "favourable" to the production process. If the correlation between the environmental characteristics z is negative, then z acts as an unavoidable output that must be produced to overcome the negative environmental condition. Therefore, in this case, we talk about "unfavourable" environmental variable z. Non-parametric naive bootstrap is used to test significance and obtain p-values. Due to the use of the ratio of conditional to unconditional efficiency scores as dependent variable, the magnitude of the coefficients obtained from these regressions cannot be easily interpreted. In line with earlier literature, we only report their sign to reveal whether larger values of characteristics z are favourable or unfavourable to efficiency (De & Kortelainen, 2013).[12]

For causal interpretation of these results, it would be important to address the potential influence of first order confounding factors (such as shifts in government due to elections or differences in remuneration policies). Moreover, the characteristic z under evaluation – in our case, regions' dependency on connected firms (*Dependency*) – should be exogenous to the outcomes of interest. We will discuss potential confounders in the results section below, but should already point out here that *Dependency* is unlikely to be exogenous. For instance, underlying levels of corruption might affect both firms' donations and public sector efficiency. As long as differences in corruption levels across the regions stay sufficiently stable over time, this can be partially accommodated via the use of region- and year-specific effects in our analysis (see below). Even so, we prefer to be on the side of caution and will refer to associations or correlations rather than causal effects throughout the analysis below.

[12] Using a simple OLS regression model instead leaves our main findings unaffected. Note, however, that due to unknown serial correlation in the efficiency scores conventional parametric methods such as OLS regression might lead to invalid inference. We return to this robustness check in detail below.

3.3. Dimension reduction for output indicators

As discussed in Section 2.2, we have 18 indicators for outputs across our three policy areas. This can be problematic for FDH models since a high number of outputs may result in a curse of dimensionality: i.e., the discriminatory power of the model is reduced such that a substantial proportion of the observations would be considered efficient. As a first, preliminary step in our analysis, we therefore reduce the dimensionality of our output space via a set of composite output measures (i.e. one for each of the three policy areas). This keeps the number of final output variables manageable without losing information (D'Inverno & De Witte, 2020). It automatically also implies that we do *not* assume that there exists one overall technology combining all outputs, but rather three separate technologies across the public policy areas. This seems credible given that infrastructure, health and education services are unlikely to employ the exact same production technology.

Practically, our three composite indicators are computed via the earlier outlined robust conditional FDH model, where the input is set to one.[13] In the dimensionality reduction, we control for environmental variables that might affect regional performance (Daraio & Simar, 2005; Daraio & Simar, 2007; Simar & Wilson, 2011): i.e. inflation-adjusted per capita regional government revenues, the share of residents younger than 15, and the share of residents older than 65.[14] This implies that in the construction of the composite indicator for region i in year t, this region is more likely to be compared with other regions that are similar in terms of their revenue per capita and age composition.

As before, the linear programming weights are endogenously determined, and set to be high (low) for aspects where the evaluated observation provides more services compared to other observations in the dataset. This accommodates for the fact that different regions might focus on different services within one policy area (e.g., regions might provide more services in specialized healthcare centers rather than hospitals). Yet, we impose weight restrictions based on observed spending shares across the relevant policy areas – which can be interpreted as preference expressions (Cusack, 1997; Cusack, 1999; Potrafke, 2017). This is necessary to avoid the situation where some regions would be assessed only on a small subset of their outputs even though they spend money also on other outputs [for an in-depth discussion about interpretation of the optimal weights, see] (Podinovski, 2016). Specifically, we set a lower and an upper bound for the weights in each policy area based on available information about public expenditures in our three main policy areas in 2011 (i.e. approximately the middle of our period of analysis 2007–2017). We impose bounds at $\pm 50\%$ around the average expenditure share of each output indicator at the country level (i.e. our restrictions do not differ across regions due to lack of more detailed information).

For education, we use official statistics from OECD (2014) to calculate the share of total education spending allocated to pre-primary (17.0%), primary (41.4%) and secondary (41.6%) education.[15] As we have for each education level three output variables, we assume weight restrictions that correspond to one third of the spending per education level. Further, we allow for 50% bounds to

[13] This model formulation is known as the 'Benefit of the Doubt' model (BoD) (Melyn & Moesen, 1991). We also explored principal component analysis as an alternative – and more traditional – approach to aggregating the output indicators. This leaves our main inferences unaffected. We are grateful to an anonymous referee for suggesting this robustness check.

[14] Note that these variables are subsequently no longer included in the conditional efficiency model that uses these composite indicators as outputs. The reason is that their effects are already controlled for here.

[15] We derive total spending in each education category by multiplying the expenditure per student by the number of students.

reach our final weight restrictions. For example, for pre-primary education, the weight for each indicator is bounded between 2.83% and 8.5% (i.e. a 50% range around 5.67%). For healthcare, information provided by ÚZIS ČR (2012) indicates a spending division across hospitals (59.2%), medical institutes (6.6%), doctor salaries (19.4%) and salaries of other medical workers (18.84%). As before, we split these spending shares equally across the available output indicators in each category and allow for 50% bounds to reach our final weight restrictions. Finally, for transport we use OECD data on road (64.21%) and rail (35.79%) expenditure (OECD, 2018), and split the former across road types proportionally to the lengths of these roads. The final weight restrictions are summarized in Table 2 and the resulting composite indicators of output for the three policy areas are in Appendix Table A3.

4. Results

4.1. The efficiency implications of political donations

In Table 3, we present our main results on how the efficiency of Czech regional governments is related to the allocation of public procurement contracts to politically connected firms. As explained in Section 2.2, the central variable in our analysis – *Dependency* – is defined as the share of public procurement contracts supplied by politically connected firms for each region and each year. The results of an unconditional FDH estimation are given in column (1), whereas columns (2) to (5) present a set of conditional models including *Dependency*. The latter allows us to examine the direction of the correlation between efficiency and the dependency on politically connected firms in public procurement. We show results without (column (2)) and with (columns (3) to (5)) region fixed effects [for similar approach see] (Cordero, Salinas-Jiménez, & Salinas-Jiménez, 2017). In columns (3) to (5), we also include a measure for the left–right orientation of the regional government, which has previously been shown to matter for public sector efficiency. The underlying proposition is that the preference of left-wing parties for higher public spending might be associated with lower efficiency [see e.g.] (Revelli & Tovmo, 2007; Borge, Falch, & Tovmo, 2008; Ashworth et al., 2014; Helland & Sørensen, 2015).[16] Finally, in columns (4) and (5), we also include year fixed effects to control for year-specific elements that affect all regions.

The results in column (1) of Table 3 show a mean efficiency score of 1.023, which indicates that the average region-year observation operates slightly above the frontier of the best practice observations. This in part reflects that our estimates account for regional heterogeneity (measured by revenues per capita and the shares of young and elderly) in the construction of composite output indicators. This encompassing approach arguably stacks the deck against us by limiting the amount of residual variation in the efficiency scores (which we require to establish any relation to firms' political connections). Even so, the difference between the minimum and the maximum efficiency scores suggests that there remains considerable variation to be explained. In the remaining columns of Table 3, the inclusion of environmental variables lowers the variation in the efficiency scores (see the reduced standard deviations) – reflecting the role of heterogeneity sources not captured by the unconditional model.

[16] One might consider adding other control variables to mitigate the potential for missing variable bias. We refrain from doing so here due to the limited number of degrees of freedom available, and the very demanding nature of our fully non-parametric estimation model for small sample sizes. Moreover, several socio-economic characteristics of the regions – including their per capita revenues and age composition – are indirectly controlled for via their inclusion in our composite output indicators.

Table 2
Outputs' weight restrictions for the composite indicator in the three service fields.

	Mean	Min	Max
Panel I: Education output			
Nr. of kindergartens	5.67%	2.83%	8.5%
Nr. of teachers in kindergartens	5.67%	2.83%	8.5%
Nr. of children in kindergartens	5.67%	2.83%	8.5%
Nr. of primary schools	13.79%	6.895%	20.685%
Nr. of teachers in primary schools	13.79%	6.895%	20.685%
Nr. of students in primary schools	13.79%	6.895%	20.685%
Nr. of secondary schools	13.88%	6.94%	20.82%
Nr. of teachers in secondary schools	13.88%	6.94%	20.82%
Nr. of students in secondary schools	13.88%	6.94%	20.82%
Panel II: Healthcare output			
Nr. of doctors	19.37%	9.685%	29.055%
Nr. of medical workers	18.84%	9.42%	28.26%
Nr. of hospitals	29.62%	14.81%	44.43%
Nr. of beds hospitals	29.62%	14.81%	44.43%
Nr. of spec. medical institutes	3.275%	1.6375%	4.9125%
Nr. of beds in medical institutes	3.275%	1.6375%	4.9125%
Panel III: Transport infrastructure output			
Roads class 2	40.86%	20.43%	61.29%
Roads class 3	23.35%	11.675%	35.025%
Length railways	35.79%	17.895%	53.685%

Note: The weight restrictions for the composite indicator are set based on available information about public expenditures in our three main policy areas in 2011. We impose bounds at ±50% around the average expenditure share in each output indicator at the country level (see columns Min and Max for the bounds). *Source*: Authors.

The conditional efficiency models strongly suggest that *Dependency* is negatively correlated with efficiency once we include region fixed effects. Adding these fixed effects implies that we focus on *changes* within the same region and directly account for any fixed characteristics of the regions (including, for instance, underlying corruption levels). Hence, although the regional structure of the Czech political environment may in itself matter for public sector efficiency, our findings highlight that *changes* in the extent of public procurement contracts allocated to politically connected firms within this regional political environment are important for regional government efficiency. More specifically, an increase in the share of public procurement contracts supplied by politically connected firms is associated with a decrease in regional government efficiency. Given the fully non-parametric nature of the model, the demanding specification, and our control for quality differences in the specification of our output indicators, this provides strong support for our central theoretical proposition.[17-] Although we are aware that we cannot interpret our results in Table 3 as causal evidence, we should nonetheless discuss potential confounding factors. A prime candidate thereby relates to elections. When elections change the regional government, this may affect both dependence on connected firms and public sector efficiency. There are two reasons, however, why elections are unlikely to be the main driver of the association we observe. On the one hand, shocks in dependency in our setting are not just due to elections, such that a substantial share of the variation in our independent variable is not linked to elections (see also Section 2.2). On the other hand, auxiliary analyses indicate that elections do not appear to create a substantial change in procurement spending patterns, which again suggests a rather limited role for elections in our setting. Our key result in Table 3 is robust to a number of alternative specifications. First, we re-estimated the model using Ordinary Least

[17] One potential mechanism behind the observed negative effect of dependency on efficiency may be related to firms remuneration structures. If connected firms have different (read: higher) salary policies compare to non-connected firms, higher dependency would be associated with inflated wage bills and higher costs for a given output. Unfortunately, we have no way to verify this empirically, but consider this an important avenue for further research.

Table 3
Unconditional and conditional FDH efficiency scores.

Variable	(1)	(2)	(3)	(4)	(5)
Mean efficiency score	1.0226	0.9901	0.9901	0.9900	0.9900
St. dev. efficiency score	0.1366	0.0179	0.0179	0.0179	0.0179
Min score	0.9849	0.8946	0.8944	0.8943	0.8943
Max score	2.0210	1.0043	1.0053	1.0023	1.0028
Observations	143	143	143	143	143
Dependency	-	Favourable	Unfavourable**	Unfavourable***	Unfavourable**
Region FE	NO	NO	YES	NO	YES
Year FE	NO	NO	NO	YES	YES

Notes: The table shows the results from a set of unconditional and conditional FDH models as formally specified in Section 3. Input in the models is per capita expenditures on public procurement and outputs in the models are composite indicators for the three policy areas (for summary statistics see Appendix Table A3). *Dependency* is defined as the share of public procurement contracts supplied by politically connected firms in region *i* and year *t*. *** p<0.01, ** p<0.05, * p<0.1.

Squares models. While this does not account for the particular nature of our data (and is arguably methodologically inappropriate in our setting; see Simar & Wilson, 2007 for a detailed discussion and proves), the OLS coefficient can be interpreted more easily and OLS allows clustering our standard errors at the regional level (which we cannot do in the non-parametric approach). Appendix Tables A5 and A6 indicate that our results are robust to this alternative, parametric empirical approach, and that clustering reduces the estimated standard errors. This suggests that we are likely to be reporting conservative estimates of statistical significance in our non-parametric models.

Second, since there may be a delay between public procurement expenditures and observed outputs, we re-estimated all models using lagged variables. Appendix Tables A7 and A8 show that this leads to similar results, which are, however, somewhat weaker in terms of statistical significance. Hence, it appears that the main effect we observe is contemporaneous, though we cannot rule out that part of the response to changes in dependency is delayed. The exact timing of the impacts requires further investigation in future research building on a longer time series.

Third, throughout the analysis thus far we directly control for potential quality differences by adjusting our output indicators. To assess the role of quality more directly, we run a number of reduced-form models with our quality indicators as dependent variables and the dependency measure as the main explanatory variable. The results are summarized in Appendix Tables A12–A14. They consistently indicate that higher dependency on connected firms in procurement allocations is associated with lower quality of public good provision. These findings are statistically strongest for the health care and education sectors, while they fail to reach statistical significance at conventional levels for infrastructure. This not only highlights the importance of controlling for such quality differences in our main analysis, but also provides further support for our central theoretical proposition.

Finally, all specifications in Table 3 include all three composite output indicators simultaneously. Yet, politically biased procurement decisions are not necessarily equally important for all output dimensions. One reason is that public procurement decisions in different policy areas may be more or less directly influenced by the regional public administration. To accommodate this possibility, we run a set of analyses looking into the results using only one of the individual composite indicators at the time. The results in Appendix Tables A9–A11 suggest that the negative relation between dependency and efficiency is most prominent for the education sector and weakest for the infrastructure sector. Although one potential reason might be that a larger part of infrastructure is provided by private-sector firms while the majority of education services involves public schools (which might affect the role and power of the public administration in the procurement decisions), this highly tentative explanation would require further substantiation in future research.

4.2. What determines dependence on connected firms?

In this section, we investigate the role of two administrative procedures for the dependence on connected firms across the Czech regions, which can help explain the mechanics behind the findings in the previous section.

The first of these is linked to suppliers' experience with procurement contracts. From a theoretical perspective, firms with previous procurement experience can be expected to have built up relations to politicians via their procurement experience. This may not only establish a relationship of trust between firms and politicians (as well as administrators), it also gives these firms valuable experience in providing services to the public sector. Such experience can work to smooth cooperation and increase the efficiency of public good provision (Witko, 2011; Goldman et al., 2013). In line with such argumentation, [p. 5] Coviello et al. (2018) find strong evidence that "contractors who have won in the past systematically deliver current works faster". This is important since public procurement contract allocations are a zero-sum game in the sense that only one firm can win a given contract. Hence, contracts allocated to politically connected firms can no longer be allocated to experienced firms.[18] This line of argument leads to the hypothesis that the share of experienced firms and the share of party donors in procurement allocation contracts are negatively correlated. To examine this hypothesis, we distinguish between frequent and infrequent suppliers. The former are defined as firms that for every year in the 2007 – 2017 period were awarded at least one procurement contract from any region in the two years preceding the year of observation. All other firms are considered infrequent suppliers.

A second institutional aspect of relevance to our analysis is that the exact nature of the procurement process may affect the share of politically connected firms among procurement contract allocations. One important element thereby is that procedural restrictions are more stringent for contracts with a total value exceeding 4,997,000 CZK (circa $249,850) – or 20 million CZK in case of construction works (circa $1,000,000). Below this threshold, contracts are not regulated by EU law. In the Czech setting, this means that contracting authorities may use the simplified so-called "below-the-threshold" procedure and the negotiated procedure without publication. Public authorities may thereby directly ask a minimum of five firms to provide bids, and are required to publish only the final outcome (e.g., a winner of the tender). Furthermore, contracts concluded under the below-the-threshold procedure are not published in the Official Journal of the European Union, and contracting authorities can choose shorter time limits for the delivery of bids. All these elements provide a setting more

[18] Note that experienced firms are significantly less likely to be a donor of the party in power compared to inexperienced firms (0.6% versus 1.5%; p<0.05). Hence, party donors tend to be different from the set of experienced firms.

tenable to favouring some firms over others. Hence, we hypothesize that a higher share of below-the-threshold procurement contracts allocated by public authorities would be associated with an increase in the share of connected firms among procurement contract winners (*Dependency*).

Another key procedural element concerns the degree to which politicians have discretionary power (Titl & Geys, 2019). The legislative framework in the Czech Republic provides a considerable range of possible evaluation criteria and allocation procedures available to public authorities, which vary substantially in terms of the restrictiveness and public visibility they impose [see also] (Palguta & Pertold, 2017). Specifically, procurement processes using the 'lowest price' framework impose a clear (and self-evident) decision criterion. In sharp contrast, contracts allocated using the 'most economically advantageous tender' (MEAT) criterion provide substantially more leeway since Czech public procurement legislation does not prescribe in detail how 'economically advantageous' should be understood (Act No. 137/2006 Coll. on Government Procurement). This framework thus would appear particularly convenient for politicians and civil servants intent on favouring politically connected firms (Titl & Geys, 2019). We hypothesise, therefore, that a higher share of contracts allocated using this criterion is associated with a higher share of politically connected firms among procurement contract winners (*Dependency*).

Lastly, substantial variation exists in terms of the openness of the employed allocation procedures. Open procurement procedures are defined as those in which any firm can submit a bid and contract announcements are made available online to any interested party. This stands in sharp contrast to procedures where contracting authorities can, for instance, constrain the bidding stage to a limited number of firms.[19] Limiting the openness of an allocation procedure makes it more prone to favouring a specific (group of) firm. Moreover, less open procedures are likely to be associated with lower competition and therefore higher per-unit prices [for empirical evidence, see e.g.] (Branzoli & Decarolis, 2015). Hence, we hypothesize that a decrease in the share of open contracts is associated with higher dependency on politically connected firms. Summary statistics for these four institutional variables are presented in Table 4.

To examine these propositions, we run a series of non-parametric regressions where *Dependency* is the dependent variable. Our explanatory variables relate to information about the share of contracts assigned to suppliers with different levels of procurement experience, the shares of contracts assigned under more or less stringent allocation procedures and the share of contracts allocated in open competition. We furthermore include region fixed effects (all specifications) as well as year fixed effects (in even columns). The results are presented in Tables 5 and A15.

Table 5 shows the results from separate regressions including only one of the key independent variables at a time (as well as region and year fixed effects). The findings in this table provide some support for the notion that the institutional characteristics of the procurement process affect the allocations of contracts to politically connected firms, and thereby help instigate the efficiency implications of political connections highlighted in the analysis above. More specifically, the results indicate a substantively strong and statistically significant positive coefficient estimate for the shares of below-the-threshold contracts and a marginally significant negative point estimate for the open tenders. Hence, the share of politically connected firms is found to be higher among procurement contract allocations that are less regulated (i.e. below the threshold) and less open. Both types of institutional frameworks allow distortions away from the most competitive bidders as well as reducing the level of competition, which benefits guiding the process towards favoured firms. Therefore, these results provide suggestive evidence on the reasons politically connected firms obtain more procurement contracts, which may subsequently induce lower efficiency scores (see above).[20]

5. Conclusion

This paper studied the relation between political distortions in the allocation of public procurement contracts and public sector efficiency. We estimate a non-parametric efficiency model that accounts for outlying observations and regional heterogeneity using a unique dataset with detailed information on public good provision, political donations and public procurement contracts in the Czech regions between 2007 and 2017. Our analysis shows substantial evidence that a larger share of public procurement contracts awarded to politically connected suppliers is associated with lower cost efficiency of public good provision. We also observe that politically connected firms obtain more contracts in regions and time periods with higher use of less restrictive and less open procurement procedures. In other words, the share of politically connected firms among procurement contract allocations seems to increase when transparency and competition in the allocation procedure are lower – to the detriment of regional sector cost efficiency.

Our findings have important implications for the design and oversight of public procurement allocation processes. In particular, the negative link between firm donations and public sector efficiency through distorted procurement allocations indicates that ties between firms and politicians should be reduced. This is consistent with earlier evidence showing that a stricter legal framework mitigates favoritism in public procurement contracts [see e.g.] (Baltrunaite, 2020; Titl & Geys, 2019). These policy implications are clearly relevant beyond our Czech setting. Moreover, they may have direct implications for the aggregate efficiency of the economy since quality of governance and government efficiency are crucial determinants of economic growth and development [see e.g.] (Olson, Mancur, Sarna, & Swamy, 2000; Méon & Weill, 2005; Méon & Weill, 2010).

Although this papercontributes to a developing literature on the efficiency costs of favouritism in public procurement (Cingano & Pinotti, 2013; Mironov & Zhuravskaya, 2016; Lehne, Shapiro, & Eynde, 2018), further research is necessary. First, our approach to measuring the potential efficiency costs of political connections can easily be applied to other sectors and countries. As mentioned, our R-code is available upon request to facilitate replications and extensions. Second, it is worth investigating how our findings translate to settings with more rigid procurement procedures. Therefore, one could study the impact of politically connected firms under more stringently legislated EU-contracts. Third, the proposed model specification is a fully non-parametric specification, which is relatively demanding on the data. While this avoids specification bias, it limits the number of control variables that can be included in the analysis. Thus, further research can test the robustness of the results by relying on more parametric assumptions of the production frontier. Finally, an alternative empirical approach would be to structurally estimate an auction model with asymmetric bidders (i.e. political donors or not), which allows assessing whether less efficient donor firms (with a higher cost structure) are systematically more likely to be granted the provi-

[19] An example of such a procedure would be so-called negotiated procedures without publication requirements.

[20] Appendix A15 shows that including all independent variables simultaneously provides qualitatively similar findings.

Table 4
Summary statistics – mechanisms.

Statistic	N	Mean	St. Dev.	Min	Max
Share of frequent suppliers	143	81.359	19.288	16.414	100
Share of contracts below the threshold	143	67.134	27.019	2	100
Share of contracts under MEAT criteria	143	37.430	33.114	0.000	99.850
Share of open contracts	143	61.281	28.288	1.288	100

Notes: All variables are measured as their percentage share in the combined value of particular contracts. Note that MEAT stands for "most economically advantageous tender".

Table 5
Non-parametric estimation mechanism results.

	(1) Dependency	(2) Dependency	(3) Dependency	(4) Dependency	(5) Dependency	(6) Dependency	(7) Dependency	(8) Dependency
Effect								
Share of below threshold	0.0461*	0.0392*						
	(0.0254)	(0.0224)						
Share of open tenders			−0.0532*	−0.0525*				
			(0.0317)	(0.0317)				
Share of MEAT tenders					0.0231	−0.0312		
					(0.0182)	(0.0283)		
Share of frequent suppliers							−0.0162	0.0275
							(0.0256)	(0.0272)
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	143	143	143	143	143	143	143	143
R-squared	0.0222	0.220	0.0397	0.261	0.0856	0.145	0.0509	0.118

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows the results from a set of non-parametric kernel regressions that include a set of fixed effects. *Dependency* (Dep.) is defined as the share of public procurement contracts supplied by politically connected firms in region i and year t. The shares of below the threshold contracts, open tenders, and MEAT tenders are measured as the shares of all public procurement contracts within these categories. The share of frequent suppliers is measured as the share of the value of this category of public procurement contracts on all public procurement contracts. P-values in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

sion of public goods. This, however, requires detailed firm-level data on (the participants and outcomes of) the procurement process, which is not available to us.

CRediT authorship contribution statement

Vitezslav Titl: Conceptualization, Investigation, Resources, Methodology, Formal analysis, Software, Writing - original draft, Writing - review & editing. **Kristof De Witte:** Supervision, Funding acquisition, Conceptualization, Resources, Methodology, Writing - review & editing. **Benny Geys:** Supervision, Funding acquisition, Conceptualization, Resources, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.worlddev.2021.105666.

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