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Corruption Risks and State Capture in Bulgarian Public Procurement

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Abstract

This paper sets out to measure and analyze corruption risks, patterns of favoritism, and state capture in public procurement in Bulgaria. It draws on two main types of data: large-scale administrative data on public procurement and the list of politically exposed persons. The analysis rests on calculating individual corruption risk indicators (or red flags), such as single bidding in competitive markets, and creating a composite Corruption Risk Index based on these indicators. It maps the distribution of these red flags over time, across different regions and markets. The analysis finds that Bulgaria shows high corruption risk among other examined countries in the European Union, with weak institutions contributing to slow gross domestic product per capita convergence to Western European countries. The results point out that corruption risks have deteriorated over time. Combining suppliers' political connections information with public procurement corruption risk data shows that connections are associated with higher risks, in particular connections to local government members and state-owned enterprises. The large-scale analysis of buyer-supplier contracting networks points at state capture patterns where groups of buyers and suppliers repeatedly connect in high corruption risk procurement contracts. Such groups have gained more power and control over a larger share of contracts since 2016. Finally, policy recommendations are provided in three areas: enhancing data scope and quality, introducing a data-driven approach to corruption risk assessment, and improving public procurement policy and practices to reduce noncompetitive tenders.

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1. Introduction

Institutional and governance challenges are key constraints that reduce Bulgaria's economic potential and private sector productivity. Bulgaria continues to lag most European Union (EU) countries on governance indicators.[1] The gap with the rest of the EU is most pronounced along institutions critical for economic growth such as the rule of law, control of corruption, and government effectiveness.[2] One critical institutional area where governance weaknesses and state capture by private interests are evident is public procurement (European Commission-DG REGIO, 2022, chapter 7). Owing to the digitalization of public procurement data in the EU and the introduction of a comprehensive national e-procurement system, auditors and judicial institutions, government analysts, businesses, and civil society now have access to electronic public procurement data, including the details of individual contracts and tenders (World Bank, 2020). For the first time, these provide tools to work with big data by discovering the cost and beneficiaries of non-competitive public procurement tenders and linking corruption risks in public procurement to state capture and identifying their economic impacts. Among others, the opentender.eu database on public procurement created by the EU-funded DIGIWHIST project allows analysts to identify and validate 'red flags' for corruption that may signal competition flaws, misuse of public funds, or outright corruption.

Reducing corruption risk in public procurement has the potential to boost private sector productivity growth (World Bank, 2022). Public procurement amounts to more than 12 percent of gross domestic product (GDP) in Bulgaria. The access to contracts thus has a major impact on the allocation of resources in the economy. It can either achieve value for money out of scarce fiscal resources and support the growth of more productive firms or result in an inefficient use of public money through helping unproductive firms to accumulate scarce physical and human capital and stay in the market. Reducing corruption in public procurement also reflects on the enforcement of competitive market structures in the economy and thus supports a policy environment that encourages competition based on innovation and efficiency instead of lobbying for policy privileges. Competitive public procurement practices can thus boost economic growth in two fundamental ways:

- Increasing the efficiency of resource allocations across firms and raising aggregate productivity growth
- Contributing to a level playing field among all firms in the economy, which encourages innovation and ensures survival and growth of the most competitive enterprises.

Against this background, the main goal of this paper is to provide a comprehensive analysis of corruption risks and state capture in public procurement in Bulgaria during 2011-2019. To measure these risks, this paper develops and validates a range of corruption risk indicators (CRIs) and builds a network-based state capture assessment framework. For measuring corruption risks, the paper calculates a composite score of individual 'red flags', called the corruption risk indicator (CRI), as an objective proxy measure of institutionalized corruption in public procurement (Fazekas and Kocsis 2020). For measuring state capture, the clustering of high corruption risk contracting relationships among buyers and suppliers is applied (Fazekas and Tóth 2016). These measurement innovations adapted to the specific Bulgarian context enable us to track the development, distribution, and structure of corruption risks and state capture across years, regions, and sectors, to name a few key analytical dimensions.

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[1] European Commission. Public administration and governance: Bulgaria. 2020. URL: https://commission.europa.eu/system/files/2021-10/bulgaria-ht0321342enn.en_.pdf.

[2] The World Bank Worldwide Governance Indicators.

The application of big data analytics to Bulgarian public procurement can support anti-corruption policy in at least two fundamental ways:

- It facilitates decisions about monitoring, audit, and investigations concerning individual transactions and organizations.
- It informs country or sector-wide policy decisions on resource allocation (for example, capacity development efforts) and regulations (for example, on reporting thresholds or publicity requirements).

2. Data used for the analysis

We used two procurement data sources for the analysis. First, all tenders and contracts were collected from the old national e-procurement portal, http://www.aop.bg. Second, we collected all publications from the new national e-procurement portal, https://app.eop.bg. We collected the data by using automated web scrapers that are adapted to the specificities of the source websites and data repositories. The combined national public procurement dataset includes 148,637 contracts for 2011–2019, characterized by 129 variables.

We also collected the Bulgarian tenders from the EU-wide Tenders Electronic Daily (TED) portal that was used for cross-checking data availability on the national portal and for the European comparative analysis as TED data are more comparable across European countries than national data. The details of data collection and processing are outlined in Annex 1.

We also collected data on politically exposed persons (PEPs) and linked it to public procurement data to carry out additional analysis. The list of PEPs was compiled by the Center for the Study of Democracy, including information from politicians' asset declarations, the Panama and Pandora Papers, and the Magnitsky Act (for details see Annex 6). The identified individuals were then linked to relevant companies based on whether a PEP is an owner or official of the company. As a result, 4,566 companies were flagged as politically connected by the Center for the Study of Democracy. We matched these companies to the public procurement data, leading to 197 unique PEP-connected firms, either as a supplier or buyer (for example, a state-owned enterprise [SOE] awarding a procurement contract) in the procurement dataset. The PEP-connected companies were parties to around 36,500 contracts (we considered PEP connection throughout the whole period for matching, that is, we adopted a time-invariant PEP definition).

3. The risk of corruption in Bulgaria

3.1 How we measure corruption risks

This section outlines the framework for measuring corruption risks in Bulgaria. It specifies the definition of corruption and the individual risk indicators (red flags), as well as the operationalization of the CRI. It reviews evidence for the validity of these indicators and CRIs.

The CRI methodology rests on identifying a range of risk factors, conducting validity tests on them, and pulling them together into a composite score. Any measurement of corruption has to start with a suitable definition of corruption in public procurement. Following academic literature as well as World Bank publications, we define corruption in public procurement as the allocation of public contracts by violating the principles of open and fair procurement to benefit some connected actors to the detriment of all others. This definition leads to a range of potentially valid individual CRIs based on vast literature offering conceptual and qualitative support for their validity. For example, single bidding is used as a risk indicator because the submission of only one bid in a tender, in a competitive market, is the simplest indication of restricted competition, allowing for overpricing or extracting rents.

Next, we validate and tailor elementary risk indicators by estimating how well they fit with the corruption definition (that is, whether the indicators behave as theory predicts). For example, it can be verified that a suspiciously short advertisement period predicts single bidding on competitive markets because short advertisement can be used to limit competition to favor one firm. The length of the advertisement period, number of days, can also be a predictor of single bidding. This allows identifying thresholds beyond which corruption risks are likely to increase substantially. In general, regression analysis is used to identify valid 'red flags' that are likely to signal corruption and to assign the values of variables, such as advertisement period length or procedure types, to groups of high, medium, and low corruption risk. The number of risk categories for a risk factor in a country is determined by their regression fit (that is, the analysis aimed to coarsen risk information while retaining explanatory power).

Ultimately, those variables are selected for inclusion in the composite CRI whose coefficients are large and statistically significant in regressions predicting single bidder contracts (or alternative outcome variable indicating institutionalized, stable corruption such as buyer spending concentration), which is the simplest sign of lack of competition. The regression setup controls for a number of likely confounders of bidder numbers, for example, (a) institutional endowments measured by type of buyer (for example, municipal, national); (b) product market; (c) contract size (log contract value); (d) type of delivered items/services (goods, services, or works); or (e) regulatory changes as proxied by year of contract award. Regressions were run for Bulgaria to best capture national specificities of effective measures to limit competition and institutional endowments.

Table 1 presents internal validity regressions on the relationship between corruption risk outcomes (single bidding) and corruption inputs (other red flags such as length of submission period and decision period, procedure type, and call for tender publication). All tests confirm the selected risk indicators.

Table 1: Internal validity regression results for the red flags used for CRI calculation

	Dependent variable:				
	Single bidding				
	(1)	(2)	(3)	(4)	(5)
Procedure type (negotiated)	0.611***				0.534***
	(0.015)				(0.017)
Procedure type (non-open)	2.047***				1.059***
	(0.022)				(0.028)
Decision period (5 to 8 days)		0.447***			0.422***
		(0.023)			(0.023)
Decision period (1 to 4 days)		1.544***			1.263***
		(0.018)			(0.018)
No call for tenders			1.488***		0.758***
			(0.017)		(0.029)
Submission period (from 5 to 8 days)				0.258***	-0.014
				(0.016)	(0.018)
Submission period (missing)				1.105***	-0.095***
				(0.014)	(0.022)
Observations	193,980	193,980	193,980	193,980	193,980
Log Likelihood	-102,755.100	-102,283.300	-103,566.100	-104,590.800	-98,962.630
Akaike Inf. Crit.	206,210.200	205,266.600	207,830.200	209,881.700	198,635.300

Note: *p<0.1; **p<0.05; ***p<0.01

Included controls not shown are: Buyer location, Buyer type, Supl. location, Contract type, Year FE, Market FE, Contract value deciles

In addition to the above internal validity regressions, we gathered external validity results. Among others, these results suggest that the presence of the abovementioned red flags increases contract award prices by 5.3 percent, which translates into a US$2.6 billion lost to corruption in 2007–2021 (for the methodology see Abdou et al. (2022); for the detailed results see the Corruption Cost Tracker website[3]). While the overpricing associated with CRIs already points at large potential savings due to effective anti-corruption, these estimates certainly represent a lower-bound estimate. For example, they only consider overpricing at the point of contract award without incorporating any cost overruns or contract delivery losses.

By averaging the validated individual risk indicators, we calculate a composite score, the CRI, which can be considered as an evidence-based proxy measuring institutionalized corruption in public procurement. The CRI operationalizes the previously described definition of corruption. It is a risk indicator that identifies procurement practices for which corruption tends to happen more often. The CRI allows for consistent comparisons across time, sectors, regions, and organizations and can be further expanded and related to using additional corruption proxies. For ease of interpretation, the CRI is calculated in the following way:

1. Each individual risk indicator is recoded as low (0) or high (1) risk with sometimes an in-between medium (0.5) category added.
2. The CRI is the arithmetic average of the so defined individual risk indicators. It is calculated for each contract.
3. As a result, the CRI falls between 0 and 1, with 1 representing the highest observed corruption risk and 0 the lowest.

Based on the validity regressions in Table 1, the following list of red flags is selected to calculate the final CRI for Bulgarian public procurement (Table 2).

[3] https://public.tableau.com/app/profile/gti1940/viz/CorruptionCostTracker/Overviewofcountries?publish=yes

Table 2. Validated CRIs ('red flags') and their definitions for Bulgarian public procurement data

Indicator name	Indicator definition
Single bidder contract	0 = more than one bid received 1 = one bid received
Call for tenders publication	0 = call for tenders advertised 1 = call for tenders not advertised
Procedure type	0 = open procedure 0.5 = negotiated/accelerated procedures 1 = non-open procedure type (for example, direct contracting) (for detailed definition see Annex 3)
Length of submission period	Number of days between publication of call for tenders and submission deadline 0 = from 12 to 183 days 0.5 = from 7 to 11 days 1 = from 1 to 6 days
Length of decision period	Number of calendar days between submission deadline and announcing of contract award 0 = from 9 to 365 days 0.5 = from 5 to 8 days 1 = from 1 to 4 days
Buyer's dependence	Shows the contracting authorities' contract share rewarded to the same supplier in a given year

Single bidding indicates that a given tender only had one bidder during the procurement process, hence there was no competition for the contract. The lack of competition is one of the main signs of corruption in the public procurement system. Single bidding can be easily extracted from the data and has the key qualities necessary for an adequate indicator (Abdou, Czibik, Tóth, and Fazekas 2021).

The length of the submission period is the time difference between the first publication date of the contract notice and the deadline until which suppliers can submit their bids (bidding deadline). A sufficiently short submission period could indicate corruption, and we find a strong connection between the length of the period and the likelihood of single bidding.

Not publishing a **call for tenders** in the official journal makes it less likely that eligible bidders notice the bidding opportunity and bid.[4] In addition, not publishing a call for tenders in the official journal weakens competition, allowing the issuer to more easily award contracts repeatedly to the same company (Fazekas, Tóth, and King 2016).

Procedure type indicates the type of procedure by which the tender will be contracted. Non-open procedures, which are less transparent and competitive, create more opportunities to limit the range of bids received and to exclude bids. Additionally, they create more opportunities for issuers to repeatedly award contracts to the same company.

[4] Some tenders do not have a call for tenders' publication despite a legal requirement, hence this indicator captures the actual and not the legally prescribed publishing practices of public buyers.

The length of the decision period is a time difference between the submission deadline and the announcement of the contract award. An overly lengthy decision period gives the opportunity for multiple legal challenges against the tender, suggesting that the issuer attempted to limit competition. Additionally, it suggests that the issuer wants to award the contract to a specific company.

Buyers' dependence indicates the share of the contracts' value awarded to the same supplier by the same buyer. A high share can indicate personal ties between the suppliers and the contracting authority, preventing the tenders to be contracted under fair competition.

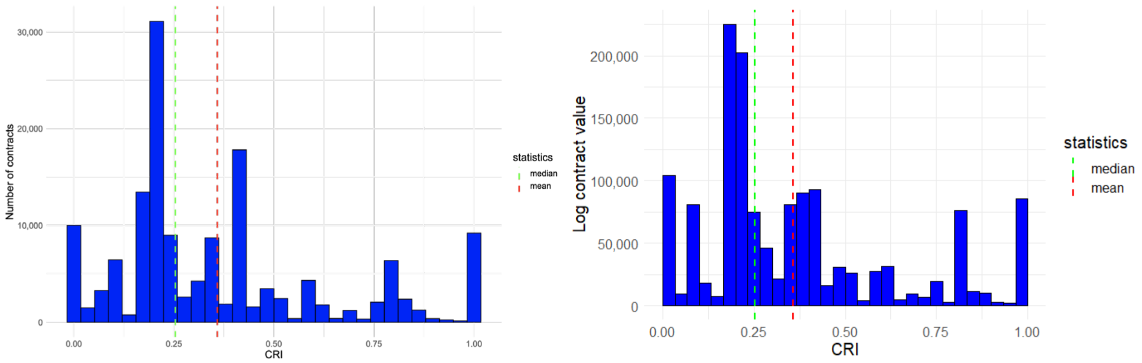
3.2 Mapping corruption risks

This section presents descriptive evidence of the distribution of corruption risks across Bulgarian public procurement on various levels such as suppliers. It also discusses differences across regions and sectors and looks at trends over time. Moreover, it offers cross-country comparative evidence to put Bulgaria's risk profile into an EU perspective. Finally, this section provides analysis of politically connected companies and their influence on corruption risks in public procurement.

3.2.1 Public procurement corruption risk distributions and trends

For almost 10,000 public procurement contracts, all six different indicators signal a high risk of corruption. The distribution of the CRI by contract number as well as by log contract value for Bulgaria from 2011 to 2019 is presented in Figure 1. It shows that the distribution is uneven with some CRI scores being significantly more frequent than others. These spikes in the distribution can be interpreted as typical combinations of risk factors or risk profiles. For example, many contracts and a large, combined value of contracts score 1, implying that all six indicators signal corruption risks. The bulk of contracts as well as awarded contract value falls within a CRI score range of 0.15–0.45, close to the median score denoted by a green line. Nevertheless, many contracts have a value above 0.5, indicating high risk (more than three out of six red flags present). Overall, the distribution is right-skewed with contracts being concentrated at smaller CRI values with a long tail to the right.

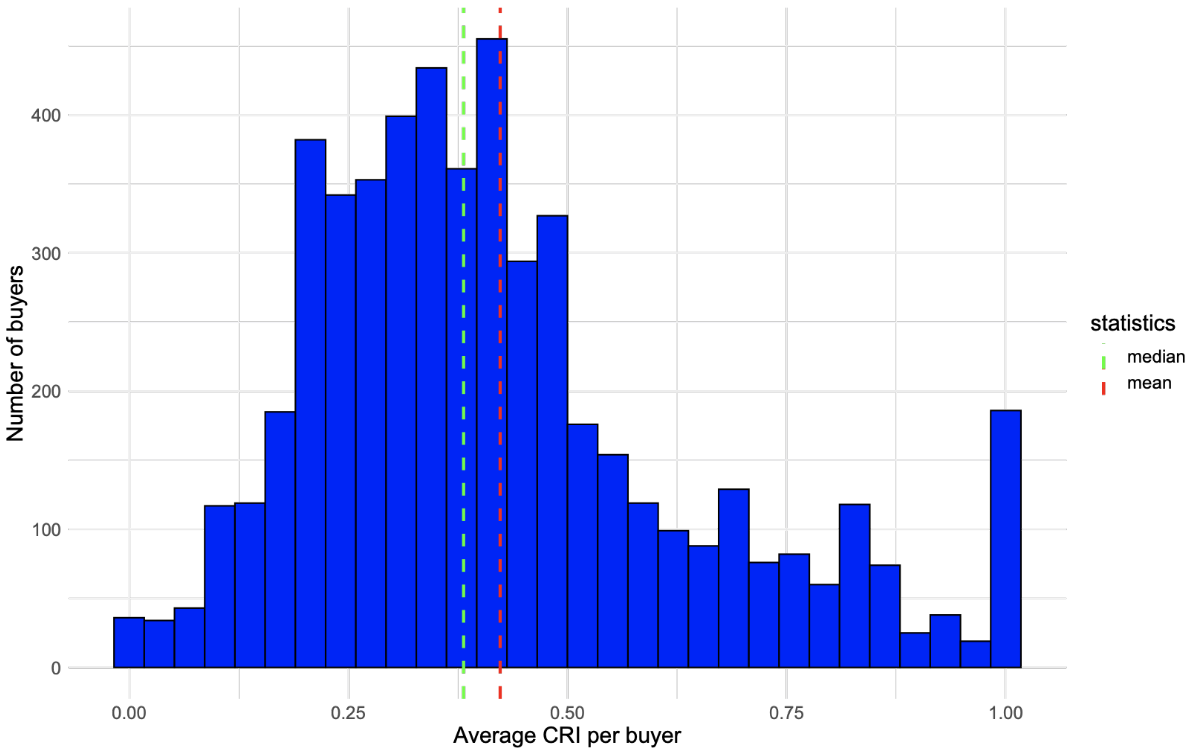
Figure 1: CRI distribution, by contract number (left panel) and by log contract value (right panel), Bulgaria, 2011–2019



Almost 200 government agencies systematically use procurement practices prone to corruption for their contracts. Arguably, CRIs at the individual contract level may be quite noisy, that is, some contracts may require exceptional procedures given product or market specificities, which can explain the presence of some red flags. However, when aggregating risk information at the organizational level, it is possible to identify more robust patterns. For example, a municipality that awards a high-risk tender every now and then may still be of high integrity but awarding nearly all its contracts with high corruption risks practices signals weak institutional control of corruption. Hence, we look at average organizational CRI scores both for buyers and suppliers. The distribution of the buyer-level

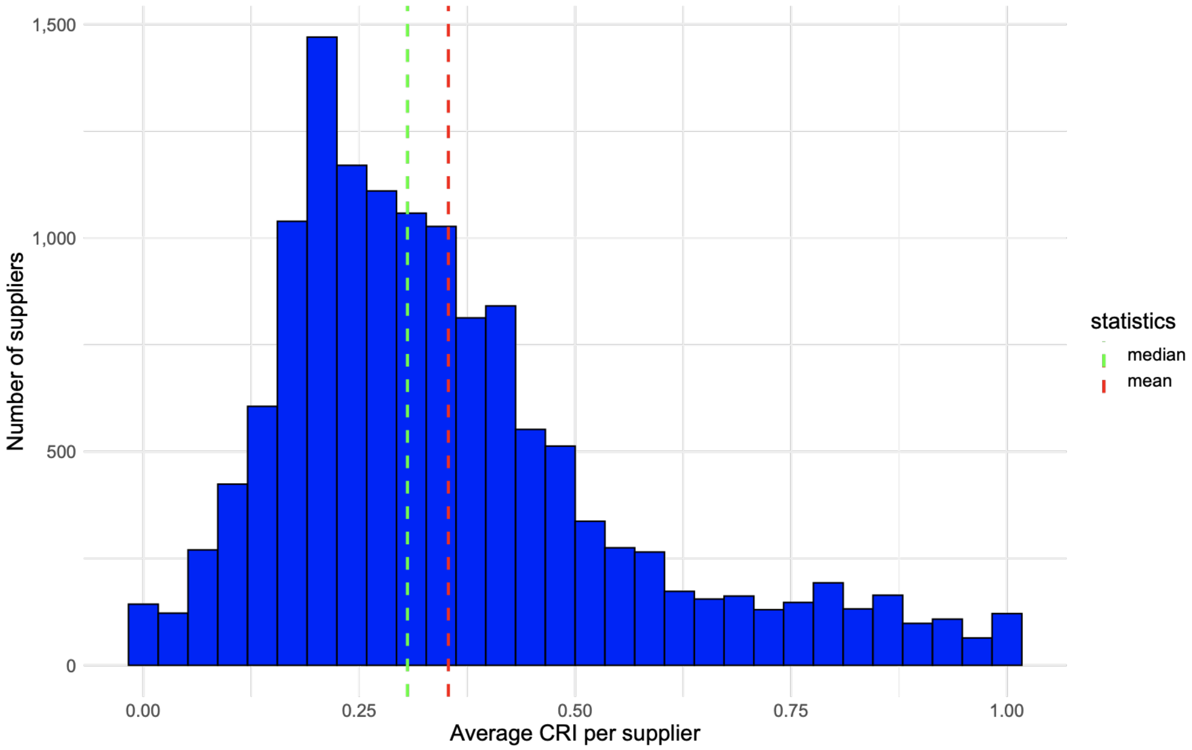
CRI is slightly skewed to the right with the majority of contracts centered around 0.3–0.4 and fewer contracts with high values (Figure 2). Moreover, the spike at the CRI score of 1 means that there is a high number of government agencies that are prone to predominantly use procurement practices identified to carry a high risk of corruption.

Figure 2: CRI distribution across government agencies (contracting authorities with at least two procurement contracts), Bulgaria, 2011–2019



While most of the awarded firms took part in procurement procedures, allowing for potential competition, there is a considerable number of firms prone to high corruption risks. We observe only a slightly different distribution of the CRI for suppliers (see Figure 3). Similar to buyers, the distribution is skewed to the right, but the majority of organizations are located in the score range of 0.2–0.25. Moreover, there is less variety in the observations on the right side of the distribution, with a significantly lower number of organizations scoring the maximum CRI. In contrast to the buyer-level CRI which is more concentrated, the supplier-level histogram is more scattered and diverse.

Figure 3: CRI distribution across awarded firms (number of contracts>2), Bulgaria, 2011–2019

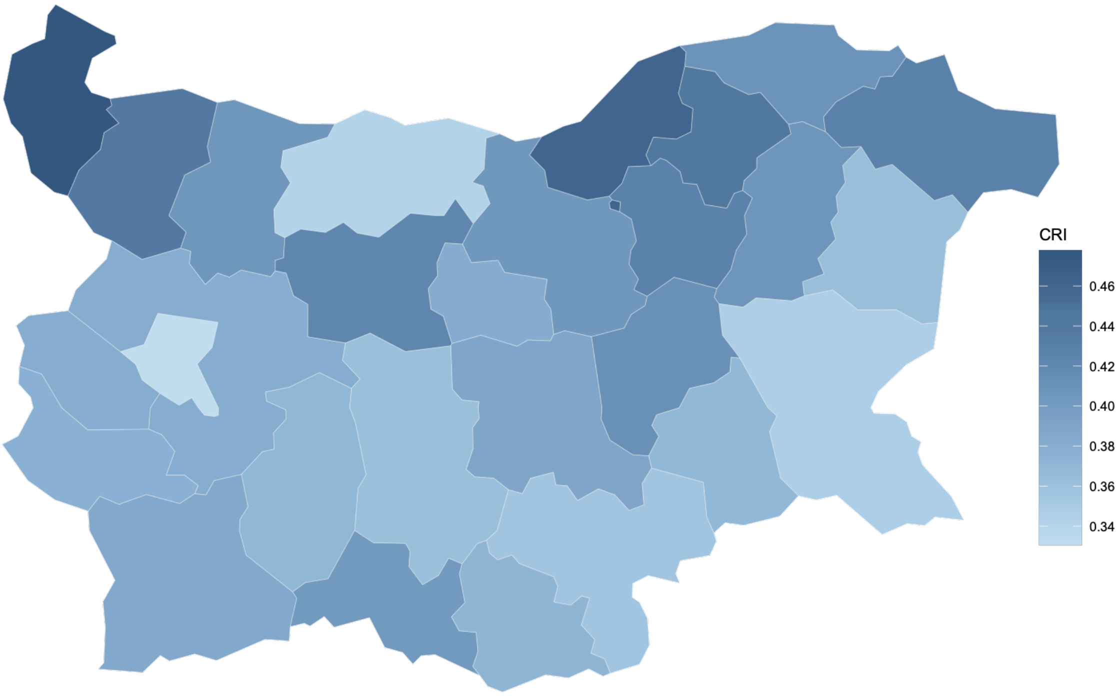


Northern regions have higher risk for corruption in procurement. To go beyond the mere description of corruption risk distributions, we now turn to the regional distribution of the average CRI across Bulgaria (Figure 4). Interestingly, there is a considerable variation across NUTS-3 regions.[5] While some districts show high integrity (for example, some of the central and southern districts), districts to the north predominantly have high average corruption risk. It should be noted that among these feature some of the least developed districts in the country in terms of GDP per capita (measured as % of the EU average in purchasing power parity, PPP)— Vidin, Montana, Dobrich, Shumen, and Lovech.[6]

[5] The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for the purpose of:
 The collection, development and harmonisation of European regional statistics
 Socio-economic analyses of the regions
In Bulgaria, NUTS-3 correspond to the country's districts.

[6] *Source:* Eurostat, indicator NAMA_10R_3GDP for 2019, accessed April 4, 2022.
These identified correlations coincide with cross-country evidence showing a negative correlation between the level of economic development and corruption, even though this literature could not overcome challenges of causal identification (see Blackburn et al. 2011; Mo 2001).

Figure 4: Average CRI by region, Bulgaria, 2011–2019



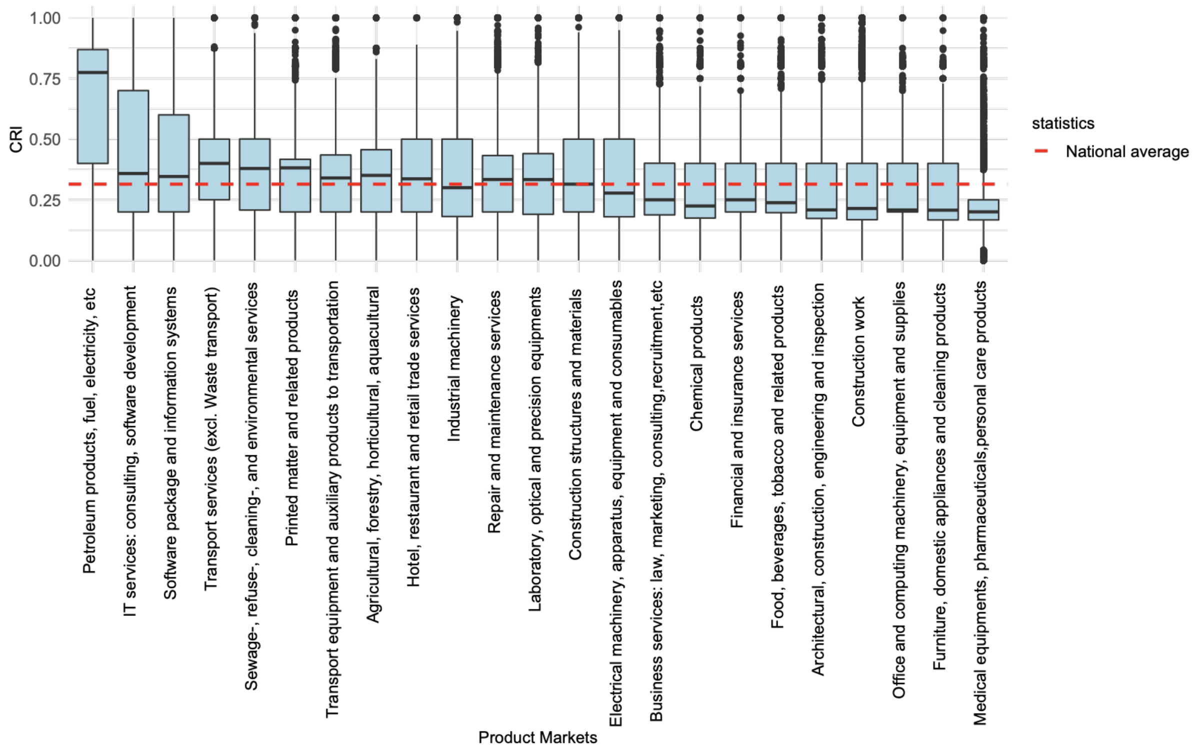
While corruption risks are present across all sectors, those dominated by SOEs and former state monopolies such as collecting and purifying water, public utilities, and fuel and electricity are most prone to corruption risks.[7] We find a wide variation of the CRI between different sectors of economy (Figure 5). On the other end of the spectrum, medical equipment and pharmaceutical products as well as furniture and domestic appliances have comparatively low CRI scores. The potential explanation for such variation can be found in specific characteristics of these sectors in the Bulgarian economy, that is, the size and competitiveness of the sector as well as the presence of monopolies.

Notably, corruption risk in public procurement is also high in professional and business services such as information and communication technology (ICT) where it contributed to inefficient resource allocations. The sector is dominated by private firms and has experienced strong growth in the period after the Global Financial Crisis in 2008-2009. Services such as IT systems and software development are typically characterized by high competition in other countries. The relatively high risk of corruption in procuring ICT services in Bulgaria suggests that many contracts have been awarded only to a few firms that tend to be less productive than their competitors.[8] This is consistent with the analysis in World Bank (2022, chapter 5) on productivity accompanying this paper which shows that despite strong competition, resources are often misallocated to less productive firms in professional business services. In other words, public procurement has contributed to resource misallocation in business services such as ICT, suggesting that these services could grow at an even faster rate in Bulgaria if corruption is effectively tackled.

[7] Please note that some of these product markets such as water utilities markets are inherently non-competitive where the expectation of competition in the absence of corruption may not be warranted. In these cases, CRI might indicate high corruption risks incorrectly.

[8] For a full discussion of the productivity effects of high corruption risk public procurement see World Bank (2022), chapter 5. Please note that this analysis finds that firms awarded with public procurement contracts with a high risk of corruption tend to have lower productivity levels than their competitors of similar size and age operating in the same four-digit sector. This analysis looks at average within-sector effects so might miss relevant cross-sectoral heterogeneities.

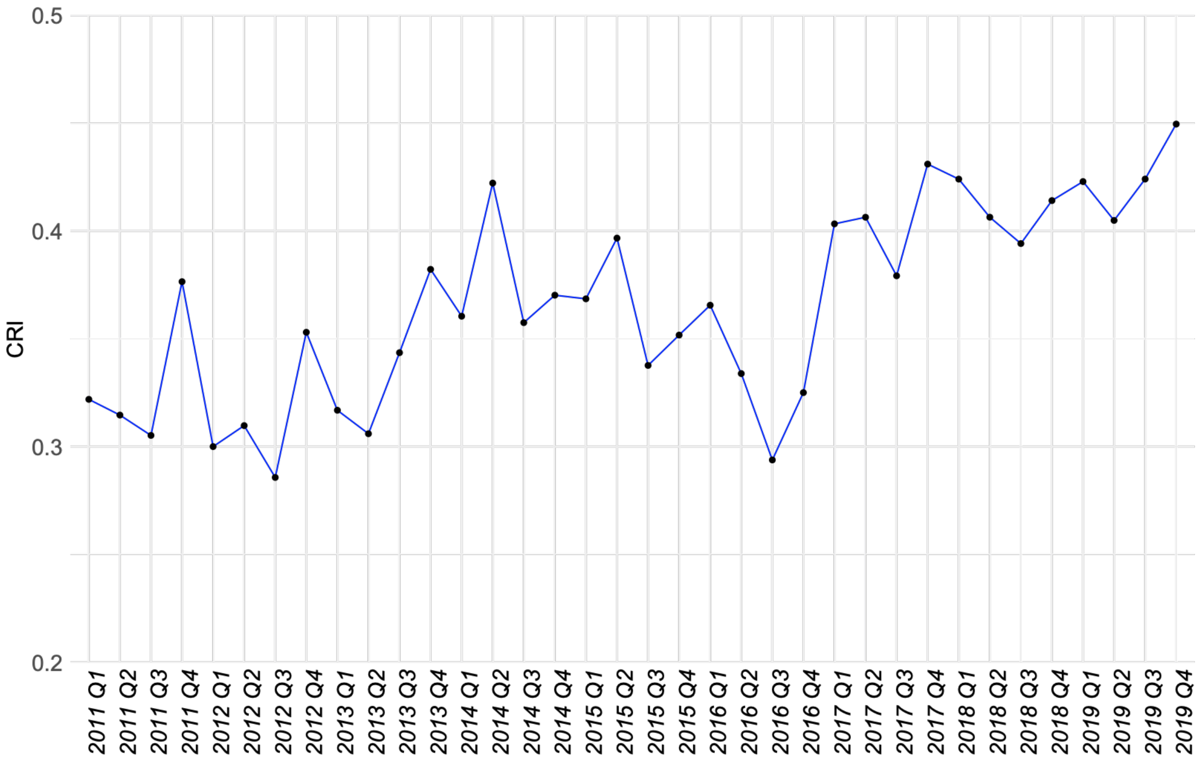
Figure 5: Box plots of CRI distributions by market, Bulgaria, 2011–2019 (number of contracts > 1,000 per market)



Corruption risk in public procurement increased by one-third from the third quarter of 2016 until the first quarter of 2017 and continued to rise afterward. The risk of corruption in procurement has increased since 2011 and this holds true particularly for the period after 2016. Quarterly CRI averages over the reference period of 2011–2019 point at a distinct upward trend in corruption risks since Q4 2016, which coincides with the election cycle, –from 0.3–0.35 to 0.4–0.45 CRI (Figure 6). This observation is robust despite considerable annual and within year variation. Moreover, there is a marked seasonality of corruption risks, largely following annual budgeting cycles: the first quarters are often characterized by a decrease in corruption risks, whereas fourth quarters typically see a jump in the CRI.[9]

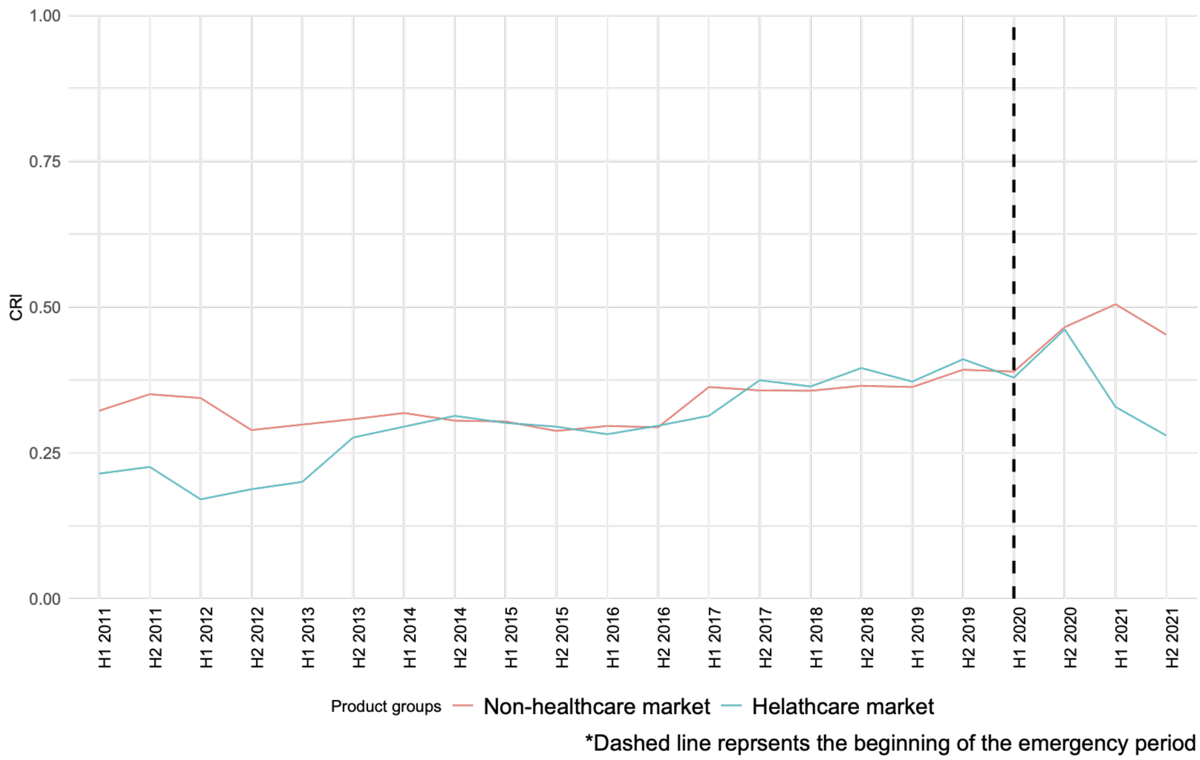
[9] This is consistent with results from the US where spending in the last week of the year is 4.9 times higher than the rest-of-the-year weekly average, and year-end information technology projects have substantially lower quality ratings (Liebman and Neale Mahoney 2017).

Figure 6: Average CRI by quarter, Bulgaria, 2011–2019



In contrast to other EU countries, uncompetitive public procurement has surged for all products since the start of the COVID-19 crisis. To look more closely at the potential corruption risks associated with the COVID-19 outbreak and increased demand for emergency products, two product groups have been analyzed: COVID-related products together with health care products and other products, not included in the first group. The distribution of trends is presented in Figure 7.

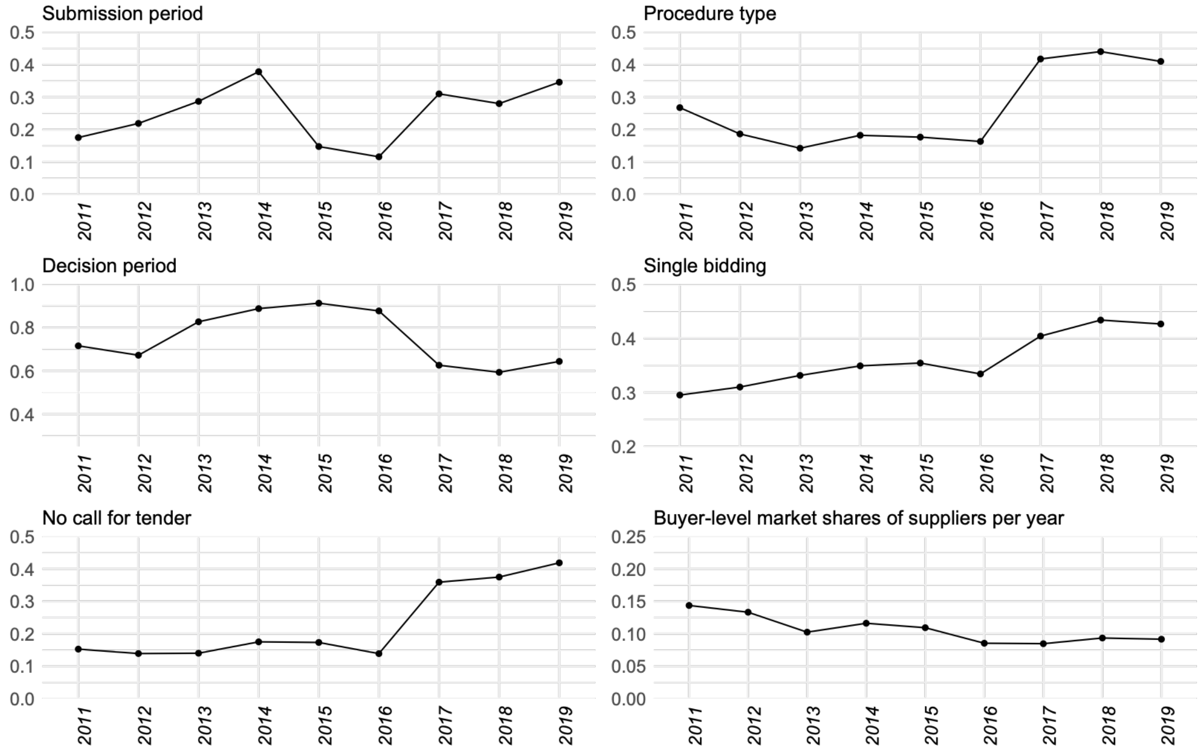
Figure 7: Health care and non-health care CRI trends, Bulgaria, 2011–2021, half-yearly averages



Since the first half of 2020 there has been an increase in both non-health care and health care markets with almost identical CRI averages until the second half of 2020. In 2021, the CRI associated with non-health care market products continued to grow, whereas health care market corruption risks went back down to its pre-COVID average. It can be observed that the introduction of the state of emergency significantly increased the CRI for health care products for a short period, while the non-health care market had the higher corruption risks even after two years of the beginning of the pandemic. Such stickiness of non-competitive, high-risk procurement practices underlines the importance of ring-fencing emergency procurement responses both in terms of product groups relevant for countering the emergency and in terms of period corresponding to the actual emergency only.

Looking at the longer period, the higher risk of corruption in procurement since the start of 2017 was driven by the more widespread use of uncompetitive procedures such as single bidding and not publishing calls for tenders. Given that the CRI is a composite score of six individual indicators, it is possible to further explore the drivers of increased corruption risks from 2017 onward (Figure 8). Most individual risk indicators are relatively flat over time. The factors that drive the overall increase in risks from 2017 onward are risks stemming from the type of procedure, single bidding, and not publishing a call for tenders. These three together suggest that the transparency and openness of procurement markets have decreased systematically since the end of 2016.

Figure 8: Annual trends for individual red flags



While high level aggregates and overall distributions of corruption risks are informative for policy development, the detailed data and risk scores also allow identifying individual high and low-risk firms and public organizations. To demonstrate this point, we show the contract-level risk profile of three buyers (Figure 9) and three suppliers (Figure 10) of different average risk levels (high, medium, low). All buyers and suppliers are considered significant actors, as they won or were awarded more than 35 contracts. We can see that while organizations of high- and low-risk profiles usually have their observations concentrated around the average value, those in the middle present scattered observations with both high- and low-risk contracts. When it comes to the relationship between contract values and corruption risks, we see no clear pattern. In some cases, tenders with lower values are more likely to be prone to corruption risks, while in others large contracts are directed to specific firms without open, transparent procedures (that is, high risks).

Figure 9: CRI and contract size (BGN) for three selected government organizations (buyers) of low, medium, and high average risk (number of contracts>35)

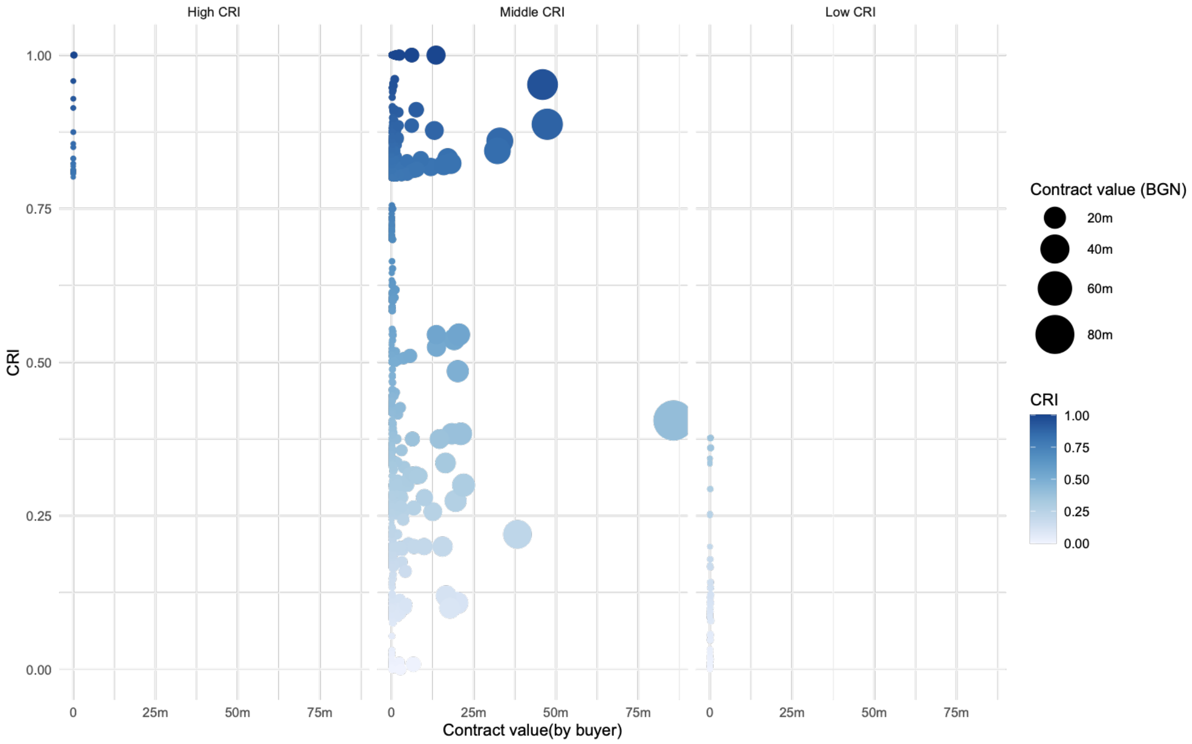
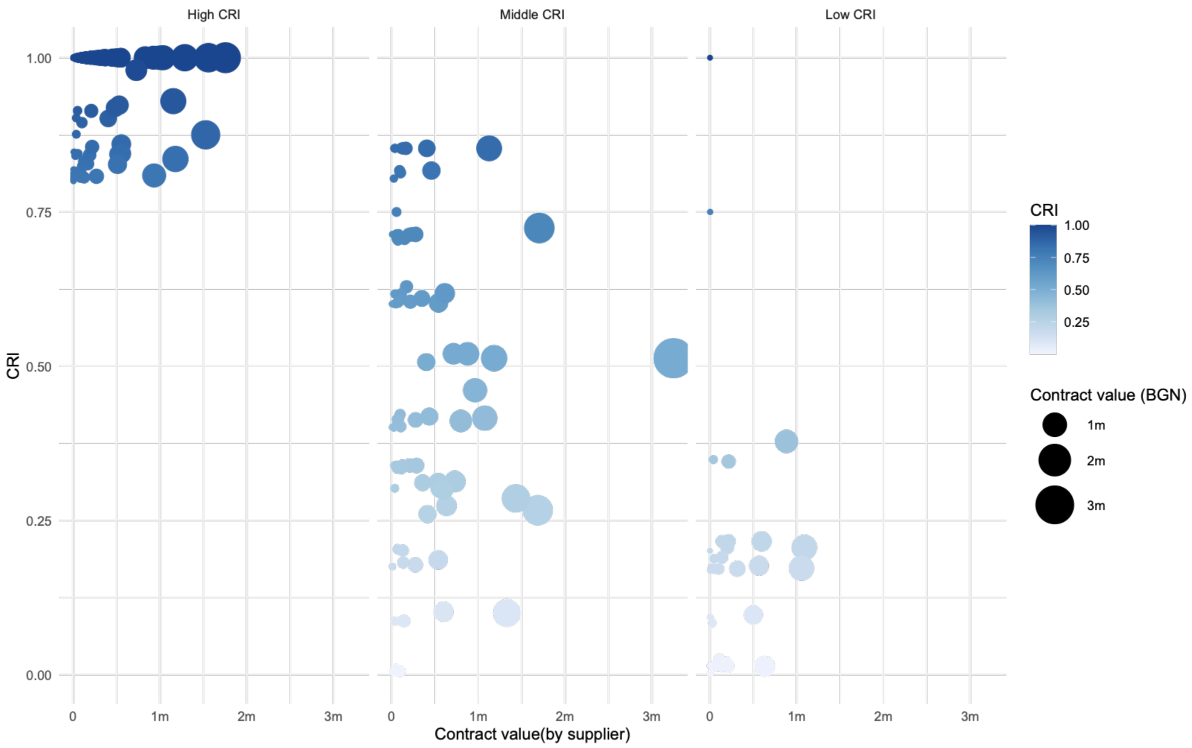


Figure 10: CRI and contract size (BGN) for three selected awarded firms (suppliers) of low, medium, and high average risk (number of contracts>35)



3.2.2 Bulgarian corruption risks from the broader European perspective

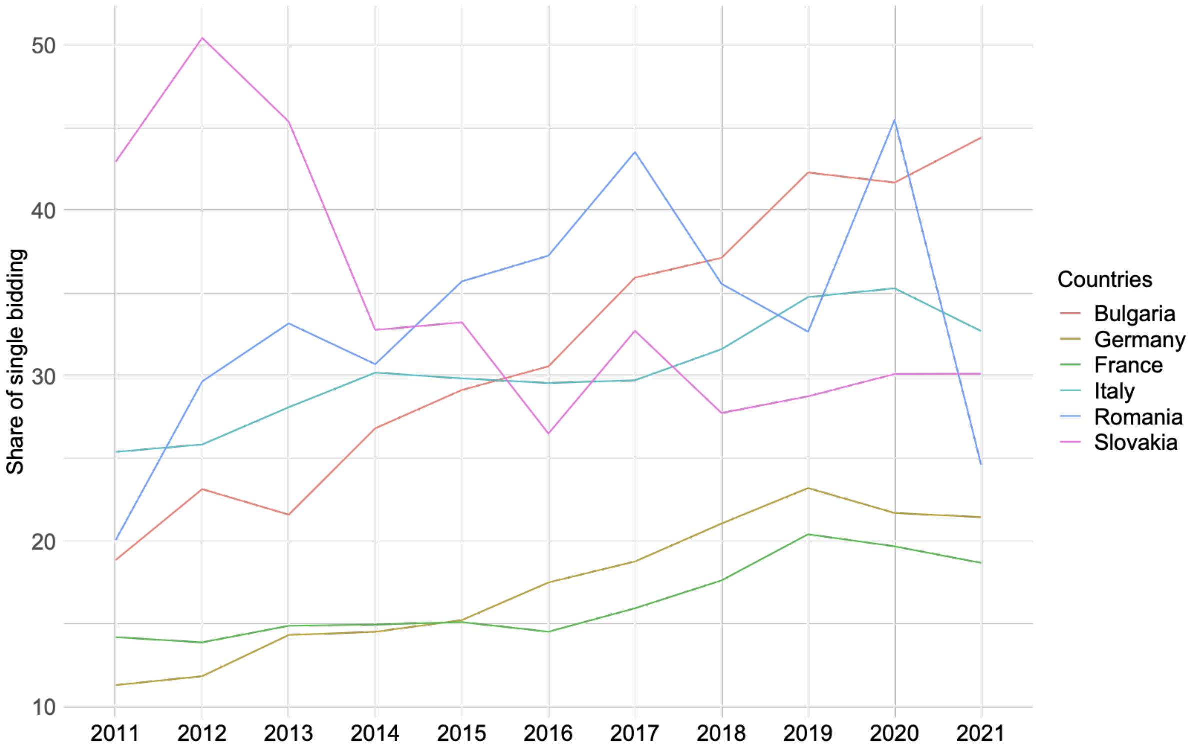
The observed trend toward lower competitiveness and higher risks in Bulgarian public procurement follows broader European trends, albeit the magnitude of deterioration is greater.

To better understand and interpret the above risk profiles and trends in Bulgaria, we compare selected risk factors to other European countries. These comparisons are based on a narrower dataset than the one used so far to make the composition of compared procurement markets more similar. We use the TED dataset which is the online version of the 'Supplement to the Official Journal' of the EU, dedicated to European public procurement. All tenders and contracts announced on TED follow the EU procurement directives, which implies that the regulatory frameworks are largely comparable across countries. TED publishes about 700,000 procurement award notices a year, including 250,000 calls for tenders which are worth approximately €670 billion. Tenders published on TED are different from national sources in many aspects, most importantly they tend to be of higher value (publication on TED is mandatory for high-value contracts albeit thresholds differ by supply type, among others). In spite of these differences between TED and national Bulgarian public procurement data, the subsequent comparisons can help contextualize and interpret corruption risks in Bulgaria.

To further increase comparability of corruption risk trends between European countries (European Economic Area [EEA] hitherto) and Bulgaria, we narrow our focus to a standard risk indicator: single bidding. Single bidding reflects the competitiveness of tenders and therefore can be a proxy for measuring potential corruption risks due to deliberately excluding non-connected firms from tenders. Single bidding is one of the most universally applicable CRIs, as it does not require identifying risk thresholds or classifying categories into risk groups. When there is only one bid submitted in a tender, the single bidding variable takes the value of 1, otherwise it is 0. For the sake of comparability, average annual values for each country are used.

The share of single bidding contracts has increased steadily in Bulgaria since 2011 and it is higher than corresponding shares in the other EU countries where data are available. First, we compare Bulgaria to selected EU member states, both among low and high corruption risk countries. (Figure 11). In this comparison, Bulgaria has featured the highest single bidding rate since 2018 relative to Germany, France, Italy, Romania, and the Slovak Republic. While there has been a consistent upward trend for most of the other countries since 2011 (the Slovak Republic is the only country which managed to lower its single bidding rate over the period), Bulgaria experienced a steady and steep increase in the share of single bidding.

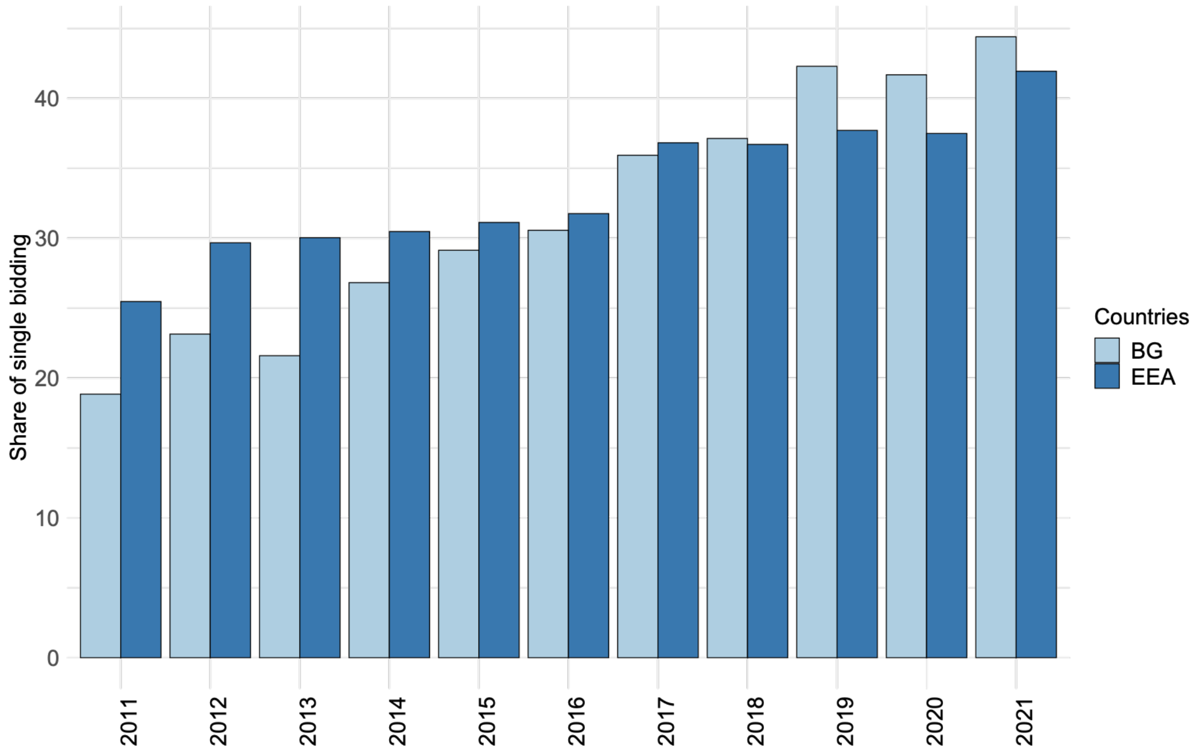
Figure 11: Annual average single bidding rates per year, selected EEA countries,[10] 2011-2021



A similar comparative pattern is revealed when comparing Bulgaria to the full EEA region (Figure 12). While the EEA region's single bidding rate follows a steady upward trend, Bulgaria's risk score increases more steeply. Even though Bulgaria starts from a lower single bidding rate than the rest of the EEA region, it eventually overtakes the EEA average in 2018 and the share of single bidding contracts remains well above it ever since. As noted earlier, there appears to be a distinct jump in corruption risks in Bulgaria in 2017 which sets the country on a high-risk path for corruption in public procurement.

[10] Note, that this figure includes all contracts regardless of their procedure type, and contracts awarded within a framework agreement as well. Therefore, the share of single bidder contracts might differ from other statistics – for example, the EU's Single Market Scoreboard excludes framework agreements and certain negotiated procedures.

Figure 12: Annual average single bidding rates per year, EEA, TED data, 2011–2021



While for the past four years (2018–2021) Bulgarian public procurement lagged the average European competition level, this difference is not yet drastic and can be reversed. In addition, it seems that the trend toward lower competition in Bulgaria reflects a broader European trend which in itself seems alarming.

3.2.3 Corruption risks of politically connected suppliers

In this section, we track the prevalence and impact of political connections on public procurement corruption risks. We find that the presence of politically connected suppliers in Bulgarian public procurement is associated with higher corruption risks on average. In spite of extensive policy and investigative focus on PEPs, their role in public procurement is not well understood due to the lack of reliable micro-data for corruption in public procurement and political connections of firms so far.

The most important question surrounding PEPs and the businesses linked to them is whether PEPs are willing to use their personal ties and connections for private gains. The analysis conducted on the Bulgarian case shows that the answer to this question is affirmative. The presence of a politically connected company in public procurement increases corruption risks by lowering competition, setting unrealistic decision and advertisement periods, or simply by increasing buyer's dependence on the same supplier.

First, we show descriptive statistics for procurement data and politically connected companies. (Table 3). The analysis is conducted on the public procurement dataset matched with politically connected persons data.[11] The matching was done first on Orbis dataset to get BVD IDs for the organizations and firms and then these IDs were linked to the public procurement data. To avoid confusion among politically connected agencies (buyers), this analysis focuses on two groups of predictors: politically

[11] The details and exact definitions of the list of PEPs are presented in Annex 6.

connected suppliers and politically connected pairs of buyers and suppliers (that is, contracts with both buyer and supplier being politically connected).[12] [13]

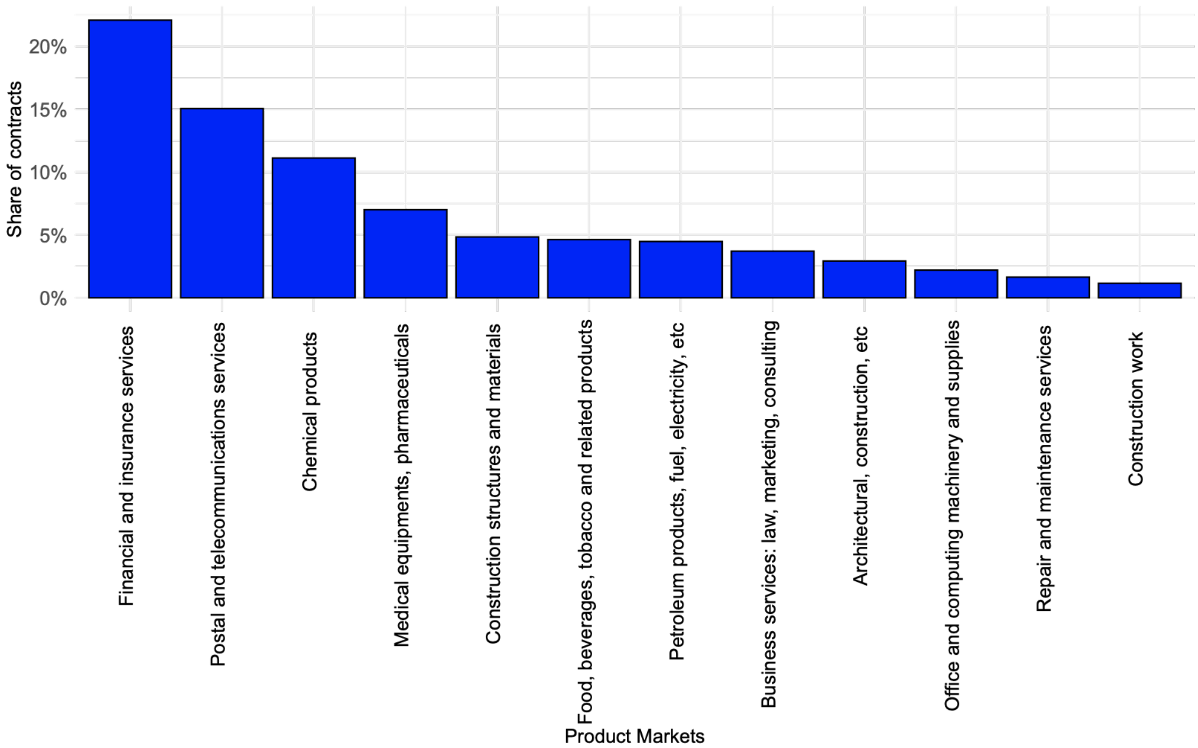
Table 3: Number of observations of political connections in public procurement dataset, Bulgaria, 2010–2019

Total number of suppliers	Number of PC suppliers (time invariant)	Total number of contracts	Number of contracts with PC suppliers (time invariant)	Number of contracts with PC pairs of buyers + suppliers
17,116	118	146,578	5,652	937

Note: PC = politically connected.

It can be expected that some product markets are more frequented by politically connected organizations than others. Moreover, this share can be used as a stand-alone red flag, suggesting the dominant role of politics in some markets.

Figure 13: Share of contracts awarded to politically connected suppliers across sectors (share of politically connected organizations per sector>7%), Bulgaria, 2011–2019



Financial and insurance services as well as postal and telecommunication services are the sectors with the biggest share of contracts won by politically connected suppliers (Figure 13), with around one-fifth of all contracts associated with politically connected suppliers.

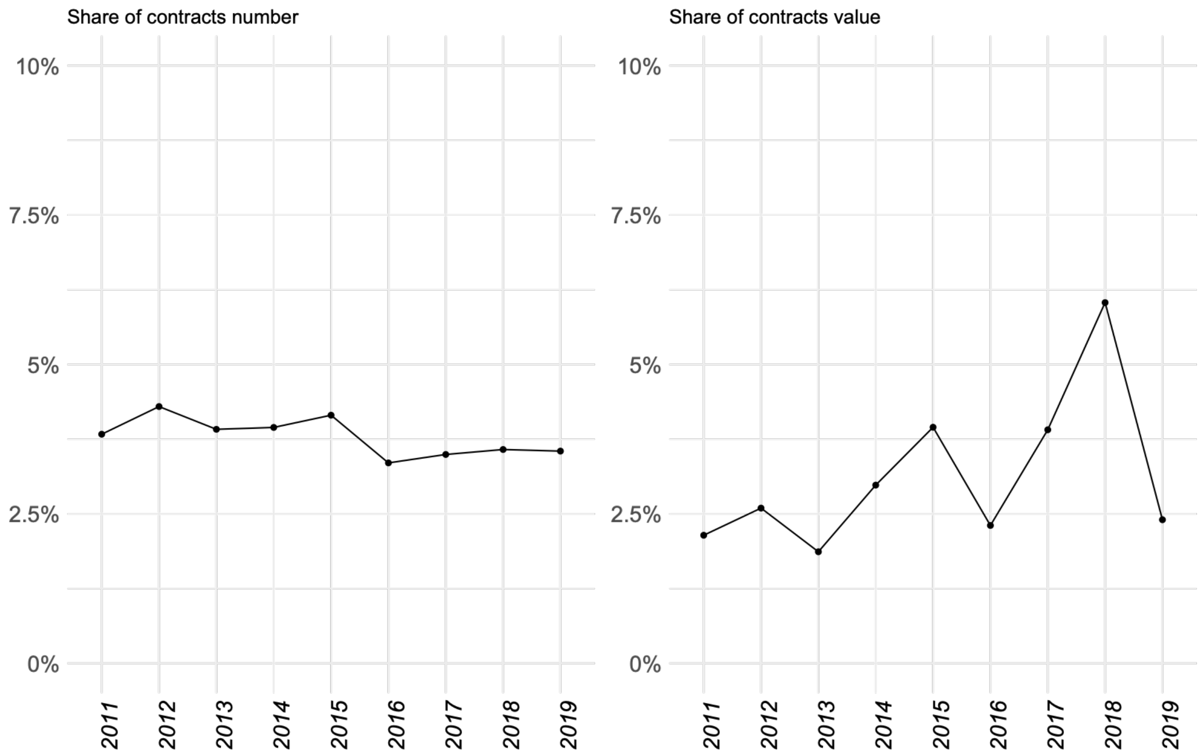
[12] The matching of PEP BVD IDs to the list of suppliers in public procurement data was performed with both strict and relaxed time constraints, that is, we have both time variant and time-invariant observations (matched by ID and year or just by ID). For the analysis we used a time-invariant list, so the PEPs were matched just by IDs.

[13] While legislations in Bulgaria strictly delimit potential conflict of interest situation, violations by Ministers and MPs are punished with relatively small fines, while for Civil Servants it is mainly disciplinary sanctions that are handed down (URL: http://europam.eu/index.php?module=country-profile&country=Bulgaria#info_COI). As shown by the analysis, some MPs in Bulgaria might be members of SOEs distributing contracts, which in this case will be considered as political connection from the buyer's side.

Second, the trend of politically connected suppliers' procurement results offers a valuable additional insight into the time trends and systemic changes observed above. The changes observed can be related to political or economic events such as elections, economic crisis, and updated legislation as they might significantly contribute to corruption risks. We show the prevalence of politically connected suppliers both by the number and total value of contracts.

While the share by contract number is relatively steady throughout 2011–2019 and varies between 3 percent and 5 percent (Figure 14, left panel), the share of contract value increased after 2016 and then dropped after 2018 (Figure 14, right panel). In 2018, the share of contract value associated with politically connected organizations accounted for around 6.5 percent of total public procurement spending. In other words, the value of contracts won by politically connected suppliers increased, while the number of such contracts stayed the same. While international comparative figures are largely missing, the closest comparison for data quality and methods comes from Hungary where the largest politically connected firms account for about 25 percent of total public procurement spending (Tóth and Hajdú 2022).

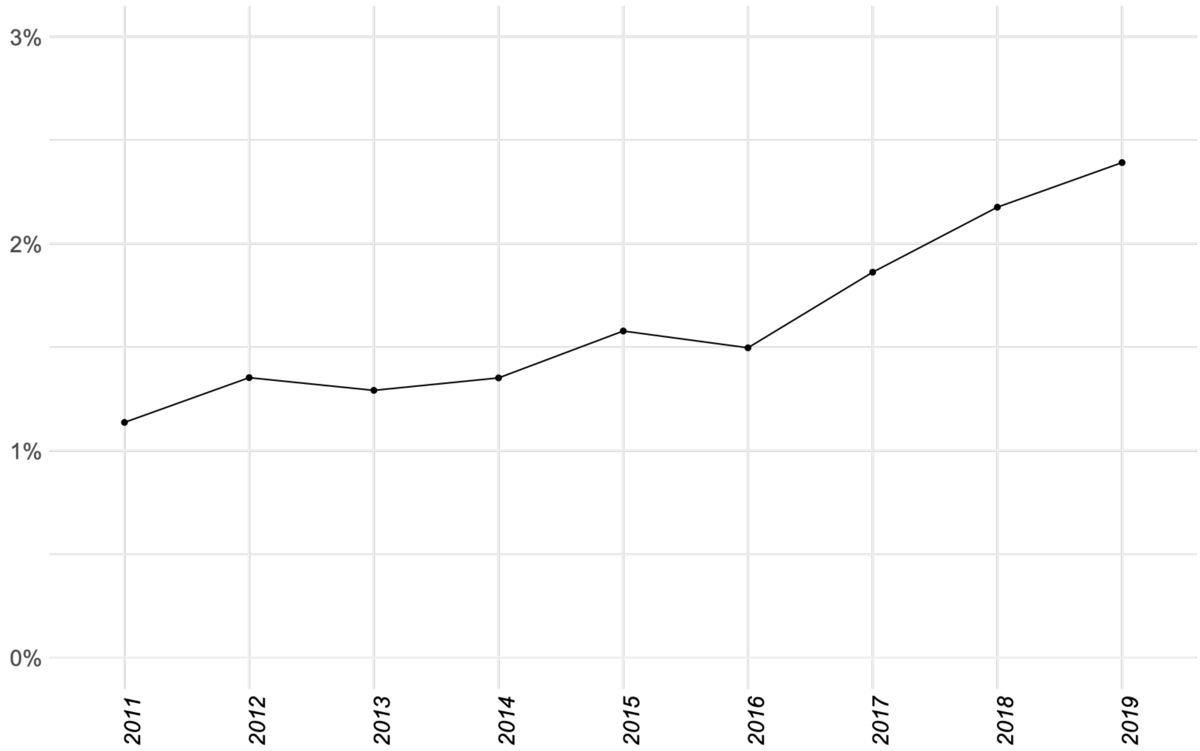
Figure 14: Annual number of contracts awarded to politically connected suppliers, Bulgaria, 2011–2019[14]



In general, the share of politically connected suppliers is low, similar to the variation across years (Figure 15). Suppliers with political connections constitute around 2 percent of all suppliers. There is little variation in the share of politically connected suppliers over time.

[14] The distribution is shown without a significant outlier with the contract value much higher than the rest of observations (possibly due to the data error).

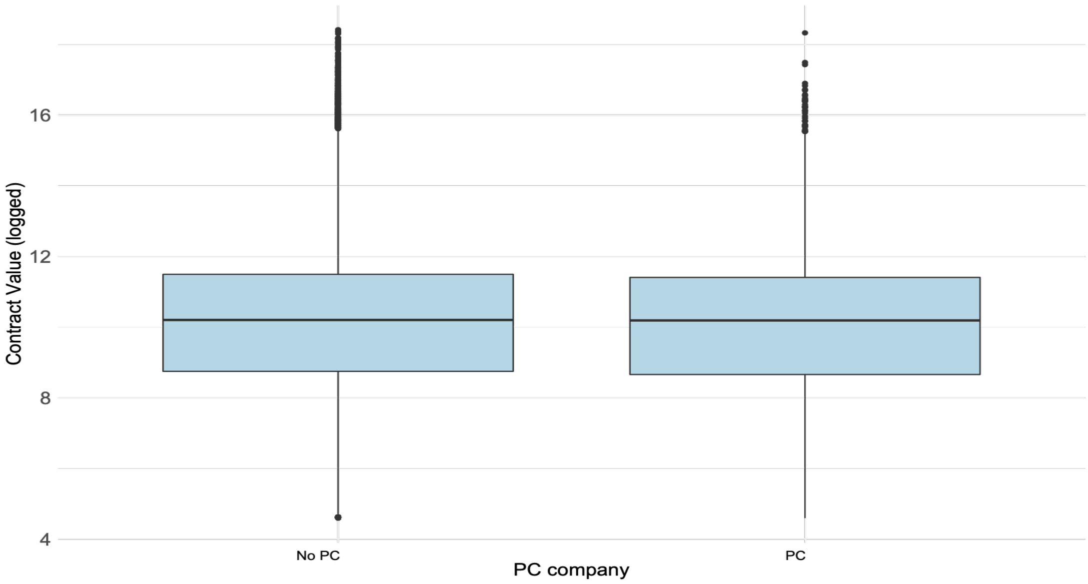
Figure 15: Annual share of politically connected suppliers. by number of organizations, Bulgaria, 2011–2019



Finally, we visually explore the difference in contract values for suppliers with and without political connections, including the distribution of outliers per each group. The median value of contracts[15] won by politically connected suppliers is almost the same as the value of contracts not associated with any political connections (Figure 16). Additionally, the boxplot of the left side shows higher variation across contract values, including both high value and small contracts. Whereas the distribution of contract values among politically connected suppliers is much more concentrated around the median value.

[15] For clear visualization, the contracts values were logged to make distribution close to normal.

Figure 16: Contract values comparison between suppliers with and without political connections, Bulgaria, 2011–2019



To test if political connections indeed influence the level of corruption risks related to public procurement, we use regression analysis in which we consider a range of determinants of corruption risks. These outcome variables are regressed on a dummy variable, which is equal to 1 for politically connected suppliers or pairs of suppliers and buyers and 0 otherwise. This analysis explains the risk of corruption (CRI) of contracts (Table 4).

Table 4. Results of the regression analysis for estimating the effect of suppliers and supplier-buyer pairs on contract-level CRI, Bulgaria, 2011–2019

Regression Results: Time invariant PEP

	Dependent variable:	
	cri	
	(1)	(2)
PC supplier, time invariant	0.031^{***}	
	(0.003)	
PC buyer and supplier, time invariant		0.035^{***}
		(0.007)
Constant	0.632^{***}	0.632^{***}
	(0.055)	(0.055)
Observations	132,521	132,521
R^2	0.451	0.451
Adjusted R^2	0.450	0.450
Residual Std. Error (df = 132291)	0.195	0.195
F Statistic (df = 229; 132291)	475.408^{***}	474.689^{***}
Note:	*p<0.1; **p<0.05; ***p<0.01 Included controls not shown are: Supl. location, Contract type, Year FE, Market FE, Contract value deciles	

Note: PC = politically connected.

The results confirm that a significant positive relationship exists between politically connected suppliers and corruption risks, with control for contract type, location, year, and market fixed effects.

Both politically connected suppliers and buyer-supplier pairs increase corruption risks in public procurement. In particular, the presence of a politically connected supplier increases the CRI by 0.031, which constitutes about one-fifth of a red flag (model 1). For the supplier-buyer pairs, a presence of politically connected pair increases the CRI by 0.035. The coefficients remain largely the same (that is, robust) after filtering small markets, small contract values, or sectors with a low share of politically connected companies.

Next, we check if different types of politically connected organizations have different impact on corruption risks. The types are defined based on the type of political connection of the PEP who co-owns the company: judicial, legislative, local government, or SOEs.

Table 5. Results of the regression analysis for types of politically connected suppliers and buyer-supplier pairs, Bulgaria, 2011–2019

Regression Results: Time invariant PEP

	Dependent variable:	
	cri	
	(1)	(2)
PC supplier with legislative PEP, time invar.	0.001	
	(0.006)	
PC supplier with local gov. member PEP, time invar.	0.051^{***}	
	(0.004)	
PC supplier with SOE member PEP, time invar.	0.062^{***}	
	(0.007)	
PC buyer and supplier with legislative PEP, time invar.		0.254^{***}
		(0.073)
PC buyer and supplier with local gov. member PEP, time invar.		0.093^{***}
		(0.035)
PC buyer and supplier with SOE member PEP, time invar.		0.119^{***}
		(0.017)
Constant	0.976^{***}	0.975^{***}
	(0.202)	(0.202)
Observations	132,521	132,521
R^2	0.459	0.458
Adjusted R^2	0.458	0.457
Residual Std. Error	0.194 (df = 132237)	0.194 (df = 132239)
F Statistic	396.373^{***} (df = 283; 132237)	398.100^{***} (df = 281; 132239)
Note:	*p<0.1; **p<0.05; ***p<0.01 Included controls not shown are: Buyer location, Buyer type, Supl. location, Contract type, Year FE, Market FE, Contract value deciles	

Note: PC = Politically connected.
Number of contracts with legislative PEP supplier = 1,779, with local government PEP supplier = 3,434, with SOE member PEP supplier = 1,369, with legislative PEP supplier and buyer = 13, with local government PEP supplier and buyer = 43, with SOE member PEP supplier and buyer = 155.

The most significant political connections among suppliers are local government members and SOEs (Table 5). The presence of local government members and SOEs in the tendering procedure increases the CRI by 0.051 and 0.062, respectively (about one-third of a red flag). While SOE member is uniformly a powerful predictor among supplier-buyer pairs (increases CRI by 0.119), legislative members show more significant results, increasing the CRI by 0.254. Interestingly, politically connected supplier alone with legislative PEP does not show significant results, which means it is the buyer's side which contributes to the higher CRI. Finally, politically connected buyer-supplier pair with local government member increases the CRI by 0.093.

Therefore, we can conclude that the presence of political connections in public procurement indeed is systematically used for private gain. Based on the coefficients presented in the regression models, this effect is not a major driver of a high CRI in Bulgarian procurement but is contributing to it. Yet, the presence of political connections also increases the contract value, which is clear from both annual and overall distributions. Markets with a high share of politically connected companies can also generate additional risks for tendering procedures and may deserve additional attention.

4. The risk of state capture in Bulgaria

This section describes our approach to estimate state capture in public procurement using large-scale network analysis. It then analyzes patterns of state capture found in Bulgaria in 2011–2019. The analysis starts off with an overview of the Bulgarian public procurement contracting network, then it moves on to identifying cohesive groups of contracting organizations where corruption is the norm. It concludes by analyzing state capture patterns in different subsamples.

This approach is complementary to the previous section analyzing political connections of suppliers as it aims to gauge the same set of phenomena. However, estimating state capture using proven and direct political connections serves as a robust, but arguably lower-bound estimate to state capture. There are plenty of connections which cannot easily be discerned from publicly available information such as asset declarations. Whereas applying large-scale network analysis to the contracting network of suppliers and buyers allows for analyzing state capture across the whole procurement market. This approach does not suffer from the risk of underestimation like the political connections-based approach, instead it may overestimate state capture. Hence, the two approaches are best utilized in tandem.

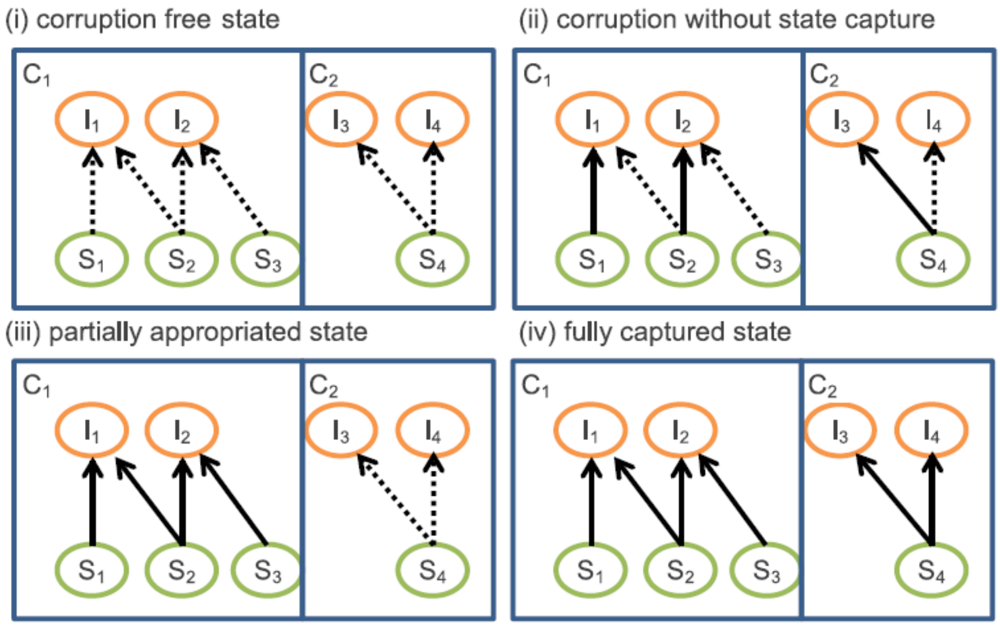
4.1. How we estimate state capture

Building on our definition and measurement of corruption, we conceptualize state capture as a group phenomenon where private sector companies along with public organizations work together to assert dominance over government contracting with the objective of extracting private rents from public resources. This definition allows for state capture to occur in both directions, whether it is the state dominating a network of suppliers or the other way around. Captured organizations then fail to foster public goals to ensure high value for public money, that is, the lowest possible price for the highest achievable quality.

We develop a measure of state capture by distinguishing between different degrees and distributions of corruption risks in public procurement across suppliers and buyers. Viewing public procurement contracting relationships as networks allows for delineating the incidence and clustering of corruption risks. In this framework, state capture is systemic corruption that results from clusters of individuals forming tightly knit cliques. On the one hand, corruption can arise from isolated attempts to manipulate procedures and extract private rents that are not systemic—that is, not clustered among the same actors over time. In this case, we cannot consider that as state capture. On the other hand, if corruption manifests itself in closed networks where all transactions have a high risk of corruption, we can consider that as state capture. The analysis of the network structure of corruption thus allows us to go beyond merely quantifying corruption risks; in particular, it permits identification of state capture networks that operate differently from both clean and randomly corrupt contracting networks.

Looking at the degree and distribution of high corruption risk, considering contractual relationships between suppliers and buyers as two distinct dimensions allows us to describe four ideal types of contracting networks: (a) clean network, (b) corrupt but not captured network, (c) partially captured network, and (d) fully captured network. We depict a simplified version of each of these network structures in Figure 17. Public organizations (issuers/buyers) and private firms (suppliers) are represented as *I* and *S*, respectively. The dashed lines represent low corruption risk contracts and solid lines indicate high corruption risk contracts. Panel (i) illustrates a clean network without high corruption risk ties in either of the two clusters (C1 and C2). Panel (ii) visualizes corruption without state capture in that high corruption risk ties are randomly distributed among different buyer-supplier clusters. This setting suggests a weakening of the integrity of the procurement system, but no systematic abuses of the participating firms and government agencies (contracting authorities). Panels (iii) and (iv) highlight two instances of state capture, partial and full. In panel (iii), the high corruption ties are concentrated in one buyer-supplier cluster, making public organizations I_1 and I_2 prone to capture but not I_3 and I_4. In panel (iv), high corruption ties dominate both clusters and public organizations and are fully captured by suppliers.

Figure 17: Theoretical network configurations of corruption and state capture



Source: Fazekas and Tóth 2016, 323.

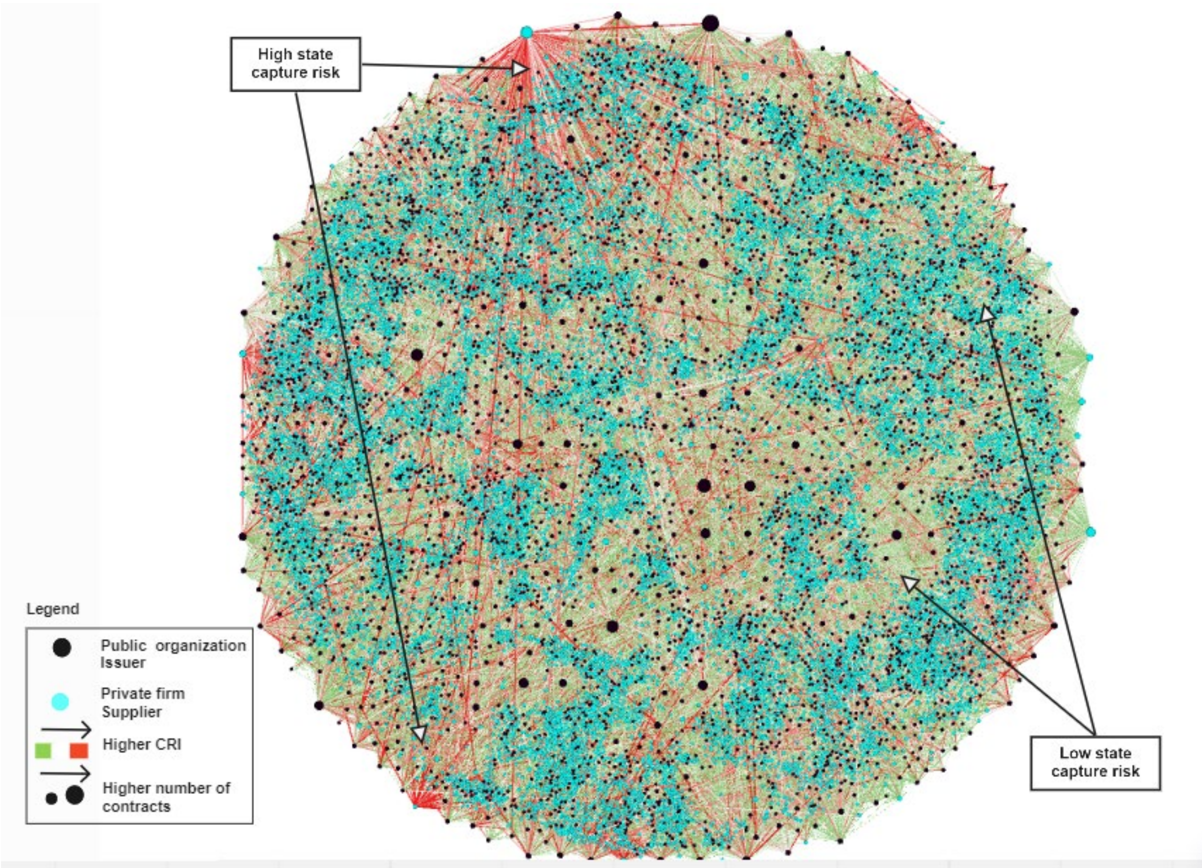
The above example is a simple representation of complex procurement activity. In practice, it is unlikely, as we will see later, for the networks to be completely separate. Contracting networks are usually characterized by dense ties within clusters and sparse ties across clusters. Moreover, the corruption risk index developed above is a continuous indicator that enables a careful assessment of risks rather than merely flagging a tie as corrupt/non-corrupt. Finally, the identified clusters may only differ with regard to the degree of corruption risk associated with their contractual relationships.

4.2. Mapping state capture patterns

This section empirically assesses state capture following the conceptual framework briefly outlined earlier. It offers insights into the structure of corruption risks and hence the degree and extent of state capture. To this end, we start by constructing the full contracting network of Bulgaria for 2011–2019. Specifically, we build a network of public procurement contracts expressing the relationship between public agencies (buyers) and private firms (suppliers). When there are multiple contracts between a buyer and supplier, the tie reflects the sum of those contracts. The ties are weighted based on the CRI score of contract(s) between any two buyer-supplier pairs. For the analysis and visualizations, we removed buyers and suppliers without ties and contracts with less than BGN 1,000, allowing the analysis to focus on key patterns and trends. As a starting point, we look at the full public procurement contracting network of Bulgaria in 2011–2019 (Figure 18). We represent public agencies (buyers) with black circles and firms (suppliers) with light blue circles. The node size shows the number of contracts awarded by the buyer or received by the supplier.[16] We color the network ties using the average CRI score of the underlying contracts where red is used to show higher values of CRI scores and green lower CRI scores. As the CRI is continuous, the ties are colored in a gradient pattern, moving from a darker shade of green to darker red for higher CRI scores.

We can see that there is mixed activity in the middle parts of the network. It is visible from the network representation that higher CRI ties are located in certain areas, for example, the right and left parts of the network. Similarly, lower CRI is also located in specific areas such as the top left parts. This type of behavior gives an indication that there are indeed groups of the same buyers and suppliers that are repeatedly partners in procurement contracts, awarded through high corruption risk procurement practices, suggesting a high degree of state capture—the same buyers and suppliers have the power to extract private rents by avoiding open, transparent procedures. In contrast, the network also shows other contractual relations between groups of buyers and suppliers that are based on using competitive procurement practices with low risks of corruption.

Figure 18: Complete bimodal contracting network, Bulgaria, 2011–2019

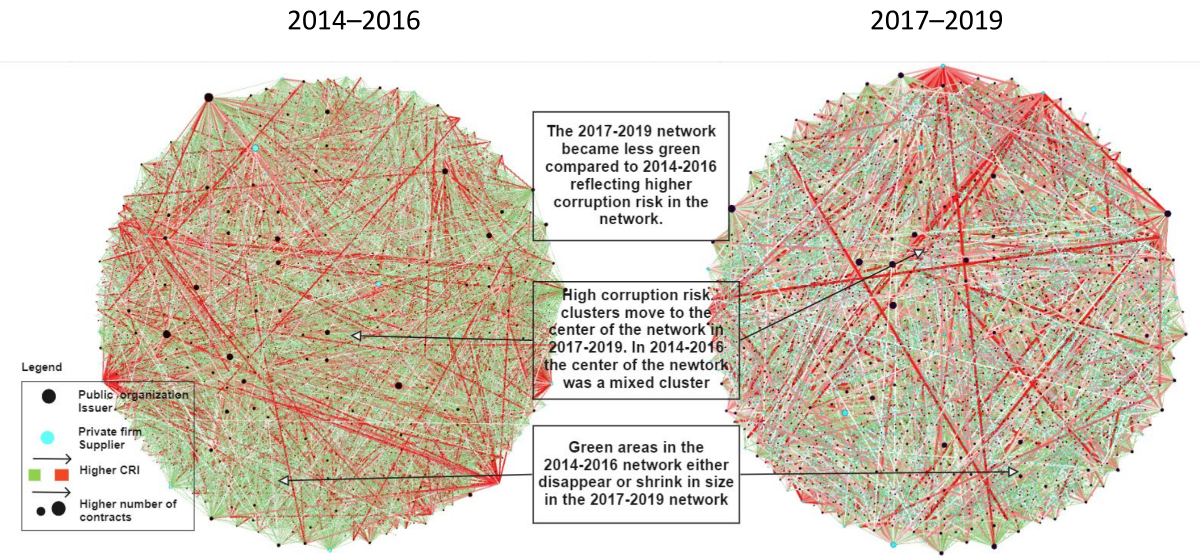


Note: The figure presents the full public procurement network in Bulgaria (2011–2019). It shows different levels of state capture patterns. We can see that buyers and suppliers in the top and bottom left parts repeatedly engage in high corruption risk interactions demonstrating high levels of state capture.

[16] Alternatively, we could make node size reflect contract value, but the distribution is highly skewed which would make the visual uninformative. In addition, state capture thrives on repeated interactions between corrupt actors, making the use of contract number conceptually a closely tied metric.

Given the earlier finding regarding the higher risk of corruption after 2016, it is worthwhile to investigate the potential structural shift that happened during the period. To verify if the average corruption risk increase was accompanied by any structural change in the network, we split our sample into two three-year periods: 2014–2016 and 2017–2019. The comparison shows that a large portion of low corruption risk of the network in 2014–2016 (green areas on the 2014–2016 panel) either disappeared or decreased in size in 2017–2019 (Figure 19). Conversely, high corruption risk ties dominate the majority of the network in 2017–2019 compared to 2014–2016.

Figure 19: Comparing contracting networks before and after 2016 in Bulgaria



Note: The figure shows two snapshots of the public procurement network in Bulgaria, 2014–2016 and 2017–2019. We can see how high corruption risk ties appear more frequently and exercise more control over the 2017–2019 network compared to the 2014–2016 network.

After 2016, the structure of state capture seems to have not changed but the existing state capture buyer-supplier clusters seem to have gained more power and expanded their control over a higher share of contracts than before. While earlier we showed a jump in average corruption risks, this analysis explores the distributional and structural impact of the increased average risks following 2016. To gain a more precise understanding of the network changes after 2016, we compare the two structures based on their aggregate network features (Table 5).

Both networks contain similar shares of buyers and suppliers and cover a comparable amount of spending, BGN 17 billion in 2014–2016 and BGN 20.1 billion in 2017–2019. The network centralization scores measure to which extent the contracting network is concentrated on few buyers-suppliers links. Table 6 shows that these are slightly lower in 2017–2019, indicating that contracting has become more decentralized, that is, being organized in localized subnetworks. The modularity score measures the extent to which there are more and stronger clusters of awarded firms and government agencies (contracting authorities). It somewhat decreases in the 2017–2019 network, indicating that the latter period had slightly fewer buyer-supplier clusters than the 2014–2016 period. Overall, these findings suggest that while there was a noticeable jump in the average corruption risk level from 2017, this did not fundamentally alter the structure and logic of state capture. Instead, what we see is highly clustered local centers of state capture which have expanded and have exerted greater control in 2017–2019.

Table 6: Network statistics for 2014–2016 and 2017–2019, Bulgaria

Statistic	(1) (2014–2016)	(2) (2017–2019)
Total contract value	BGN 17.02 billion	BGN 20.74 billion
Average CRI	0.36	0.40
Nodes Buyers Suppliers	13,885 2,815 (20%) 11,070 (80%)	9,661 1,907 (20%) 7,754 (80%)
Edges	28,764	19,263
Graph density	0.0003	0.0004
Clusters	284	150
Modularity (stronger clustering of buyer-supplier ties)	0.617	0.550
Betweenness centrality[a] (higher values given to buyers/suppliers that create shorter paths between two nodes)	0.111	0.082
Eigenvector centrality[a] (higher values given to buyers/suppliers that are connected to buyers/suppliers with more ties)	17.582	12.462

Note: a. These aggregated centrality measures are network measures based on the centrality scores of each node in the network. The higher the centrality scores, the more likely the nodes that are further apart will interact through central agencies/firms.

To probe potential areas of state capture, we investigate the behavior of high- and low-risk portions of the buyer-supplier network separately and contrast them with each other. In line with the above theoretical model, we expect high-risk contracting relationships to be clustered if state capture is a widespread phenomenon in Bulgaria. We thus split the network into two subnetworks, representing the bottom 30 percent and top 30 percent of the average CRI of the contracting relationships. In addition, we use algorithms to detect buyer-supplier clusters that are characterized by a dense web of connections among them but by sparse connections with other buyer-supplier clusters.[17] We display the low and high corruption risk groups of buyers and suppliers separately in Figure 20. In these figures, the nodes are colored according to the identified clusters.[18] Clusters across both low- and high-risk portions of the contracting network are highlighted with the same color, that is, it is possible to see if the same network is present in the high- and/or low-risk parts of the network. In an imagined world, clusters would appear in only one of the subsamples (either bottom 30 percent or top 30 percent) which would indicate either complete state capture (if it only appears in the top 30 percent) or no state capture (if it appears in the bottom 30 percent sample).

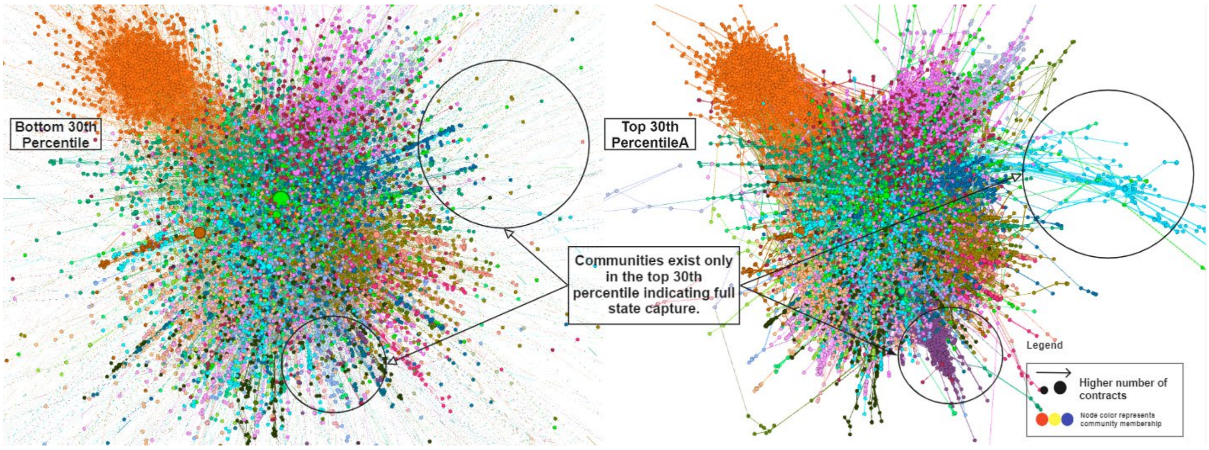
The coloring of clusters reveals that most clusters contain low- as well as high-risk contracts, which suggests that there are few completely captured groups. Instead, the public procurement network in Bulgaria reveals different degrees of state capture among public agencies and the awarded firms. On the one end of the spectrum, we can identify, for example, the orange cluster on the top left of the

[17] Specifically, we run the community detection algorithm in Gephi (Bastian, Heymann, and Jacomy 2009) which implements the modularity algorithm proposed by (Blondel et al. 2008) on the complete network. The algorithm identifies clusters based on organizations' proximity to each other where the higher tie weights act as an attraction force to get nodes with similar edge weights and more interactions closer.

[18] The identified communities are automatically assigned different colors to each node belonging to that community/cluster.

two networks graphs. This cluster appears in both panels of Figure 20, indicating that it is partially captured as nodes within these agency-firm clusters, which share both low and high corruption risk ties in roughly equal proportions. On the other end of the spectrum, we can also identify clusters that almost exclusively appear in the highest corruption risk network. For example, the sky blue and purple clusters on the right panel behave more like fully captured buyer-supplier networks—the same firms and agencies seem to be signing public contracts predominantly through closed, untransparent procedures with barely any low corruption risk contracting relationships.

Figure 20: Networks based on CRI percentiles, Bulgaria, 2017–2019 (left: bottom 30%, right: top 30%)



Note: The figure shows the public procurement network in Bulgaria, split based on CRI percentiles. The organizations are colored using their cluster membership which is based on an organization's network proximity to the other organizations. We can identify the cyan and purple clusters that only appear in the right panel (top 30 percent sample) and almost disappear in the left panel (bottom 30 percent sample). This indicates that these clusters show strong patterns of state capture. The organizations within these clusters are repeatedly engaging in high corruption risk interactions.

To further investigate the key differences between the low and high corruption risk networks, we look at a range of network features characterizing how centralized these networks are—that is, to what degree they are organized into clusters pointing to state capture or clean contracting relationships (Table 7). In part by design, the two networks are comparable in their overall structure and size.[19] However, a range of network features are more different across the two networks. The high corruption risk network is somewhat less dense than the low corruption risk network. In addition, the high-risk network is organized into more clusters. The high corruption risk network is also slightly less modular than the low corruption risk network. This means that clusters in the high corruption risk network have more ties across other high corruption risk clusters than within the same cluster.[20] Underpinning the argument that corruption is organized and systemic—that is, state capture is present in Bulgaria—the high corruption risk network is more centralized than the low corruption risk

[19] Naturally, the numbers of edges are almost the same (we picked the 30th and 70th percentiles of the edge CRI distribution), 30 percent and 31 percent of the total number of edges of the complete network in the bottom 30th percentile and top 30th percentile, respectively. The bottom 30th percentile accounts for 34 percent of total spending while the top 30th percentile accounts for 29 percent of total spending. The total number of nodes is slightly more (10 percent more) in the top 30th percentile sample compared to the bottom 30th percentile sample.

[20] Higher modularity scores indicate that nodes have denser connections with nodes in the same cluster (module) compared to nodes in different clusters (modules).

network. Buyers and suppliers in the high corruption risk network have more interactions among themselves compared to other agencies and firms that are only in the low corruption risk network.[21]

Table 7: Network statistics for the complete network and low/high corruption risk, Bulgaria, 2017–2019

Statistic	(1) Complete network	(2) Bottom 30th percentile	(3) Top 30th percentile
CRI percentile value	—	0.20	0.52
Total contract value	BGN 20.74 billion	BGN 7.10 billion	BGN 4.86 billion
Nodes Buyers Suppliers	9,664 1,907 (20%) 7,754 (80%)	3,684 848 (23%) 2,836 (77%)	4,678 1,572 (34%) 3,106 (66%)
Edges	19,263	5,267	5,964
Graph density	0.0004	0.0008	0.0005
Clusters	150	135	245
Modularity (stronger clustering of buyer-supplier ties)	0.550	0.707	0.654
Betweenness centrality[a] (higher values given to buyers/suppliers that create shorter paths between two nodes)	0.082	0.094	0.158
Eigenvector centrality[a] (higher values given to buyers/suppliers that are connected to buyers/suppliers with more ties)	12.462	1.167	11.313

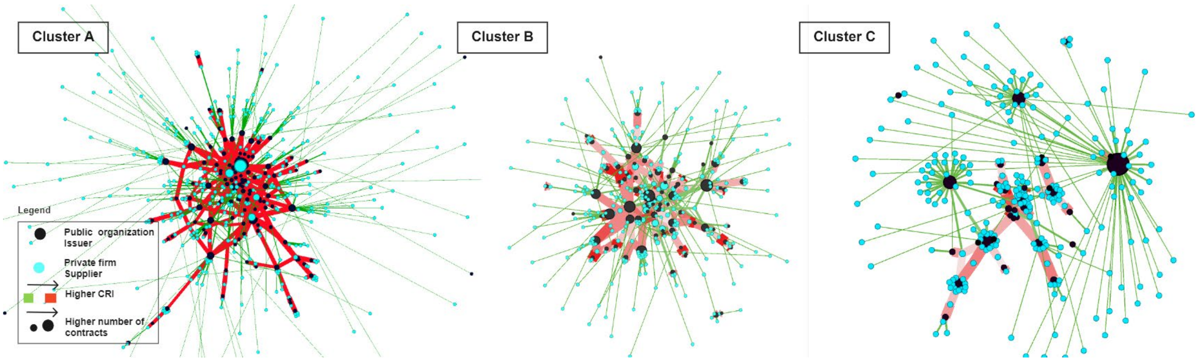
Note: a. These aggregated centrality measures are network measures based on the centrality scores of each node in the network. The higher the centrality scores, the more likely the nodes that are further apart interact through central agencies/firms.

To illustrate the different types of state capture patterns found in Bulgaria, we show in Figure 21 the three largest clusters found in 2017–2019. Cluster A is the largest cluster and although it is not fully captured, it demonstrates a high risk of state capture pattern where the high corruption risk ties dominate the center of the network with the lower corruption risk ties remaining on the periphery. Cluster B is the second largest and shows a partial state capture pattern as well. High corruption risk ties are found in the center, mixed with other low corruption risk ties.[22] Cluster C shows a network with several centers that are not captured and one captured center. This shows a pattern where high corruption risk procedures are not conducted in a systemic pattern throughout the network.

[21] Each of the betweenness and eigenvector centralization metrics are commonly used network-level metrics stemming from the node-level centrality scores. The betweenness centralization attributes higher centrality scores to nodes that are connected to more edges. A node's eigenvector centrality, on the other hand, considers the importance of neighboring nodes as well. In our case, the top 30 percent sample has a higher betweenness centralization of 0.158 compared to 0.094 for the bottom 30 percent subnetwork. Similarly, the top 30 percent sample also has higher eigenvector centralization of 11.313 compared to 1.167 for the bottom 30 percent subnetwork. This indicates that activity in the high corruption risk subnetwork is conducted in a more centralized pattern compared to the low corruption risk subnetwork.

[22] It is also observed that the high corruption risk ties in cluster B have lower CRI scores than the corruption risk ties in cluster A.

Figure 21: Three largest clusters showing three degrees of state capture, Bulgaria, 2017–2019



Note: The figure shows the different state capture patterns in the largest three clusters in the public procurement network in Bulgaria 2017–2019. Cluster A shows a pattern of high state capture as high corruption risk ties dominate the center of the network. Cluster B shows a partial state capture pattern. Although the network is centralized around high corruption risk ties, they have lower risk scores compared to cluster A. Cluster C shows a pattern where high corruption risk procedures are not systemic as the network consists of many centers that are not dominated with high corruption risk ties.

5. Conclusions and policy lessons

Based on the analysis, a set of data-driven policy recommendations can be put forward. Some of the recommendations provided in this section aim at improving the data infrastructure underpinning any future analysis, while others point at ways to improve public procurement policy and practice.

5.1. Improve the data publication framework

Data publication is generally of high quality, and a wide range of variables is available on the procurement notices. The share of missing data, including tender and organization identifiers, is low compared to many European countries. Yet, further steps are needed in the following directions:

1. Improve the access to and usability of the detailed public procurement data by introducing a bulk download option for structured data covering tenders published on both the old and the new national portals with clear distinction between tenders published according to the national threshold regulation versus those above the EU threshold regulation.
2. Limit the number of different publication templates. The use of 20+ different publication templates increases the chance of data errors.[23] Despite the many notice types, unawarded/cancelled contracts are only revealed indirectly in award notices.
3. Identifiers can be missing and not well structured, which makes it hard to connect tenders and contracts related to the same organizations. While the IDs for contracting authorities are mostly complete, unique identifiers are often missing for contractors.[24]
4. Missing values: certain fields are missing from the publications, such as information on subcontracting, consortia, or estimated prices. These should be stated explicitly in the source of each tender/lot.[25]
5. Additional data improvements: introduce clear correspondence between lots and resulting contracts. Multi-lot tenders often result in fewer contracts and it is not always possible to track such cases.[26]

5.2. Introduce continuous monitoring of corruption risks and use data-driven insights in day-to-day policy making

The analysis in this paper demonstrates the viability and potential of data-driven corruption risk analytics in Bulgaria and beyond. Communicating and making good use of such complex and rich datasets is nevertheless a challenge. Currently, a trove of datasets relevant to anti-corruption monitoring and policy making exists in Bulgaria. However, most users in the public sector and beyond lack advanced data science techniques to work with the data directly. Instead, users have varying levels and types of expertise, requiring a flexible and easily accessible way of communicating data-driven insights and supporting policy reform. This will be best achieved by using an interactive dashboard that contains not only the source data but also performance and risk indicators and warns the user about data quality shortcomings and analytical challenges. The dashboard could start by

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[23] For example, there are only three publications that are 'Социални и други специфични услуги – комунални услуги'.

[24] For example, https://app.eop.bg/today/121395, https://app.eop.bg/today/124511.

[25] For example, each tender should contain explicit information on whether it is a public tender/framework/dynamic purchasing system.

[26] Note that useful improvements have been already made to address this issue. Awarded contracts refer to lot numbers (or to a list of lot numbers) on the new procurement portal, which allows connecting lots with contracts in principle. Furthermore, the 2019/1780 regulation prescribes publishing item level submitted prices - albeit they are sometimes missing and the number of bids submitted to individual lots are not yet traceable.

displaying public procurement data and gradually evolve into a comprehensive anti-corruption data system through linking further datasets. The implementation of a comprehensive data analytics framework needs to rely on supportive regulations, organizational setup, and sufficient resources, as well as advances and investments in technological solutions.

Recommendations:

1. A flexible and easy-to-use dashboard for data-driven corruption risk assessment should be developed and gradually the underlying data scope should be extended by linking it to additional datasets.
2. The data scope could further be expanded by linking it to high-value datasets, allowing for a more comprehensive and detailed risk assessment. Such datasets could include, among others, beneficiary ownership data or data on sanctions and convictions.
3. High-quality data on investment projects and performance as well as its easy access and disclosure can facilitate oversight by relevant public institutions, enable monitoring by civil society, and promote confidence and consultation of both domestic and foreign investors.
4. Depending on the desired scope of the dashboard, Bulgaria will need to prioritize different kinds of data and conduct an in-depth assessment of the institutional, organizational, technological, and resource changes that may be required to move toward a more comprehensive corruption risk dashboard.
5. To ensure the continuous improvement and fine-tuning of the corruption risk framework developed in this paper, it will be important to establish a feedback loop in which results of the analysis are incorporated into the design of future analytics.

5.3. Improve public procurement and budget policies

Based on the analysis of individual red flags in Bulgaria and the available evidence around the world, a number of specific improvements can be made to the current public procurement regulatory framework. We review each of the key risk factors and propose specific reform pathways below.

1. Fostering competition is essential for the reversal of the decline in corruption control in Bulgaria in the last few years. Single bidding is one of the strongest determinants of high prices and below-optimum quality in public procurement. While a high number of bidders should not be pursued at all costs, lowering the incidence of tenders with no or little competition is a safeguard for value for money in public procurement (Fazekas and Blum 2021).

Recommendation: Foster competition to further reduce the number of single bidder contracts and increase the average number of bidders. Competition can be promoted by breaking down market entry barriers and by reducing the transaction costs of competing.

Implementation: Borges (2019) shows that more open (less restrictive) technical and financial conditions in tenders can lead to stronger competition, hence greater savings. Furthermore, matching tender sizes to the market capacity and median bidder size can also successfully increase the number of bidders. For example, breaking up large tenders into smaller lots can help smaller enterprises compete. It is also crucial to make sure that open tender procedures apply and this practice is not used to engage in noncompetitive procedures such as direct negotiations. Moreover, Fazekas and Kocsis (2020) show that bid evaluation criteria, which are more concrete and objective, encourage a higher number of bidders and lower corruption risks in the EU. The implementation of such interventions could be closely monitored using real-time public procurement data and the dashboard advocated earlier.

2. Improving tender design by allowing more time for bidding. Short advertisement periods can lead to a lower level of competition and suboptimal tender performance, while they are also often corruptly abused to exclude non-connected bidders.

Recommendation: Limit the use of short advertisement periods so that potential bidders have adequate time to submit their proposals.

Implementation: Policy makers should directly influence advertisement periods by setting minimum required lengths and closing loopholes for short periods. Moreover, advertisement periods can be indirectly influenced by training contracting authorities on the importance of high-quality tender designs. Furthermore, guidance for suppliers on efficient preparation of tender documentation can help smaller companies compete. Related to these interventions, making full use of e-attestations (that is, the electronic storage and verification of certificates and other official documents) also allows to cut down the administrative burden of bidding and hence enables bidders to submit quality bids in a relatively short time frame. The implementation of such improvements in tender design could be closely monitored using real-time public procurement data and a dashboard of the type advocated earlier.

3. Reducing the use of non-competitive types of procedures. After 2016, there has been a significant increase in corruption risks due to the more frequent use of non-open procedure types in Bulgaria. Closed procedures, such as direct negotiations and awarding, significantly increase prices and often lead to contract implementation delays. One of the widely used corruption techniques is applying non-open procedure types in an unjustified way, for example, splitting contracts so that the value of each part is below the threshold of the required open procedure. Although this practice does not necessarily aim at corruption rent extraction—institutions might use it to decrease the administrative burden by avoiding a difficult procedure—it certainly weakens competition and transparency and hence increases the risk of corruption. The implementation of such requirements could be closely monitored using real-time public procurement data and a dashboard of the type advocated earlier.

Recommendation: Increase the share of open procedures among all tenders to guarantee the broadest possible participation of bidders.

Implementation: The use of non-open procedure types can be decreased both through regulatory and capacity-building tools. National legislation can be amended to make it harder to use direct awards, negotiated procedures, and other non-open procedure types. For example, it is possible to lower the thresholds for the mandatory use of fully open tendering or amending the procedural requirements for invitations to tender, making them more open (for example, requiring the submission of four bids rather than merely requesting three bids). The use of central frameworks for widely used standardized goods such as office supplies could be further encouraged or made mandatory (Fazekas and Blum 2021). Training procurement officials on the use of pro-competition tendering practices, including the efficient use of open procedure types could further complement the above regulatory changes.

4. Increasing the publication of calls for tenders. We documented a sizable increase in the absence of call for tenders after 2016 which not only decreases transparency but affects corruption risks and market competition. If a contracting authority does not make a call for tenders publicly available, only connected bidders will know about the tendering opportunity. This corruption technique is strongly associated with using non-open procedure types, but it can also take place independently of them.

Recommendation: Require the publication of a call for tenders as well as the most essential procurement documents, in all or nearly all tenders.

Implementation: It is relatively straightforward to introduce legislative changes that require the publication of a call for tenders, including all relevant conditions for bidding, for all or nearly all tenders. The implementation of such requirements could be closely monitored using real-time public procurement data and the dashboard advocated earlier.

5. Improve budgeting practices to limit end-of-year inefficiencies. We documented a sizable increase in corruption risks at the end of each year (quarterly CRI jumps in the fourth quarter of most years since 2011). This is most likely due to pressures to spend allocated budgets at the end of the financial year, otherwise next year's allocation will be lower (this is the so-called 'December fever'). The need for spending the remaining budget quickly increases the room for corruption and inefficient spending.

Recommendation: Introduce more flexible budgeting rules limiting end-of-year rushed spending.

Implementation: There is a range of good budgetary practices for limiting end-of-year spending inefficiencies. Allowing carry-over of funds from the end of one fiscal year to the next represents a simple adjustment that can cushion at least some of the detrimental effects. Moreover, allowing organizational units to retain some of the savings made during the financial year could greatly dampen motivations for rushed spending at the end of the year. More fundamentally, abandoning incremental budgeting practices for alternatives such as performance or program budgeting could largely eliminate the documented inefficiencies and heightened corruption risks.

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Annex 1: Public procurement data

Main data processing steps

First, all publications describing a tendering process were scraped (Annex 2 details the list of the publication types for the two national data sources downloaded and processed). Second, the relevant fields of each publication were cleaned and parsed into a standardized, structured dataset.[27]

One tender is described by multiple publications, for example, it usually has a call for tenders (or contract notice) and a contract award document, but sometimes also a modification, cancellation, or contract implementation notice. All the relevant publications are grouped together by their tender IDs (nnnnn-yyyy-xxxx).

Once all publications of a tender are grouped together, a 'mastered' record for each tender is created with the aim of storing the values of each tender detail that can be regarded as the best estimation of the actual tender implementation. For example, CPV codes or the buyer names are published usually in more than one publication, hence only one of the values is kept so that there is one clean buyer name, one clean set of CPV codes, and so on, related to each tender.

As tenders can award one or more contracts, each contract needs to be stored as a separate observation. This can be a complex problem as multi-lot tenders—that set out to conclude multiple contracts by design—announce multiple lots in the call for tenders documents which eventually do not necessarily overlap with the number of concluded contracts, that is, the details of the competition that are in the call cannot be clearly linked to each contract as one contract covers multiple lots. Framework agreements are another exception, as they are first 'pre-awarded' to companies and then the follow-up award (or contract implementation) publications set out the details of the actual contracts.

Once the dataset is compiled, it goes through several stages of filtering, that is, selecting the observations relevant for the analysis. There are two main selection criteria: (a) contracts that are awarded and most likely lead to actual spending of public funds and (b) records with high-enough quality of information for analysis. The observations are filtered by removing records with missing bidder name, missing buyer name, cancelled lots, and non-awarded parts of framework agreements. As a result of filtering, the final, **contract-level** dataset has 220,000 (with 144,000 between 2011 and 2019) observations. This number was reduced from the initial 538,000 observations, most of which had missing bidder names due to contract cancellation, non-awarded part of framework agreement, and so on. For 2011–2019, the dataset has 20,438 unique bidders and 4,982 unique buyers, based on BvD ID.

A current key issue is related to the observations of 2020. First of all, the first half of 2020 is not scraped. Additionally, some publication types in 2020–2021 are not adequately processed. Therefore, current figures show distribution in the time frame of 2011–2019, with the exception of Figure 7 representing quarterly distribution of three markets before and after the introduction of state of emergency due to COVID-19 outbreak.

To visualize and track annual and quarterly distributions of outcome variables, 'year' and 'month' variables were also created. The main date variable based on which year and month were identified

[27] We use the DIGIWHIST data standard that was specifically developed for storing information on public procurement contracts from Europe: https://docs.google.com/spreadsheets/d/13pGIpt47sMBnZ68E-N-hMLiErpDB1CQwZzd2MXIlq5U/edit.

is the award decision date. Yet, due to the number of missing values, in cases where there is no observation for award decision date, year and month were taken from the bidding deadline, call for tender date, or contract date, depending on the availability of data.

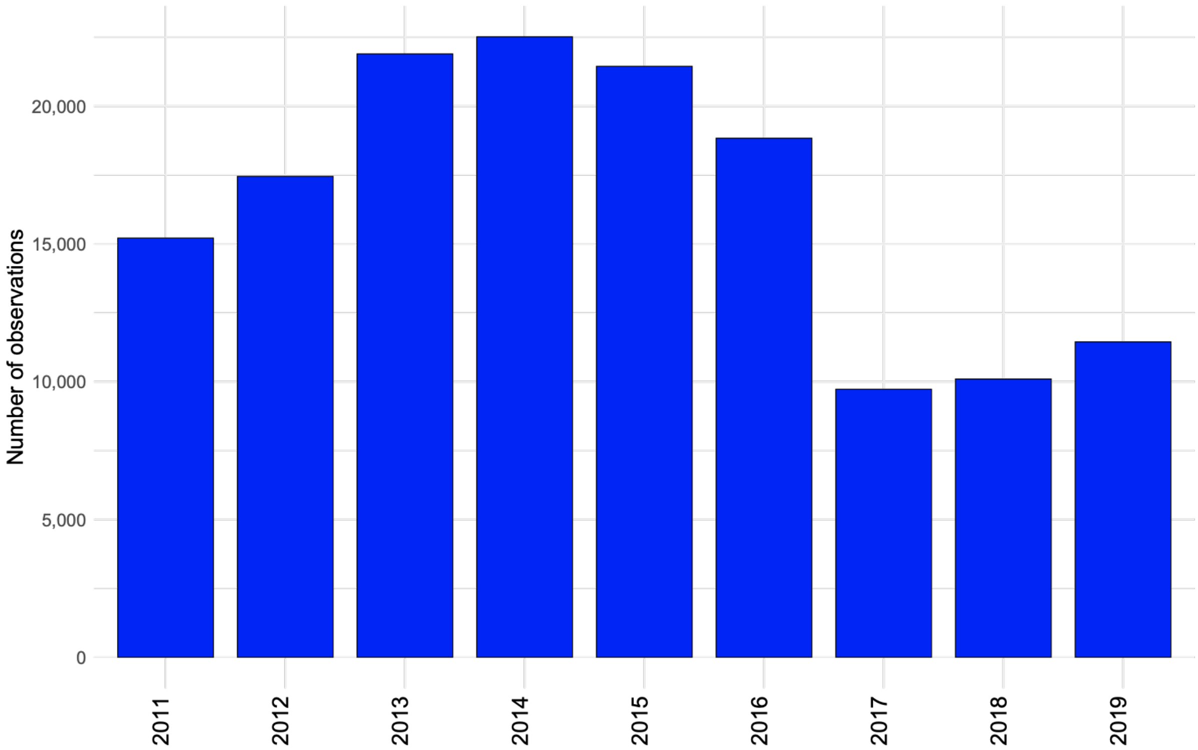
As a result of these data processing steps, we create a final data table for analysis in which each row corresponds to either an awarded contract or a lot.[28] The final list of variables is presented in Annex 3.

The public procurement dataset was enriched with company information enabled by matching BvD IDs to the public procurement contracts data. The details of the organization matching process are in Annex 5.

Overview of the final dataset used for the analysis

After filtering and narrowing down the dataset, the final number of contracts is 148,637, described by 129 variables (for 2011–2019). As we can see in Figure 1.1, the biggest number of observations is from 2012–2016, with a decline after 2017.

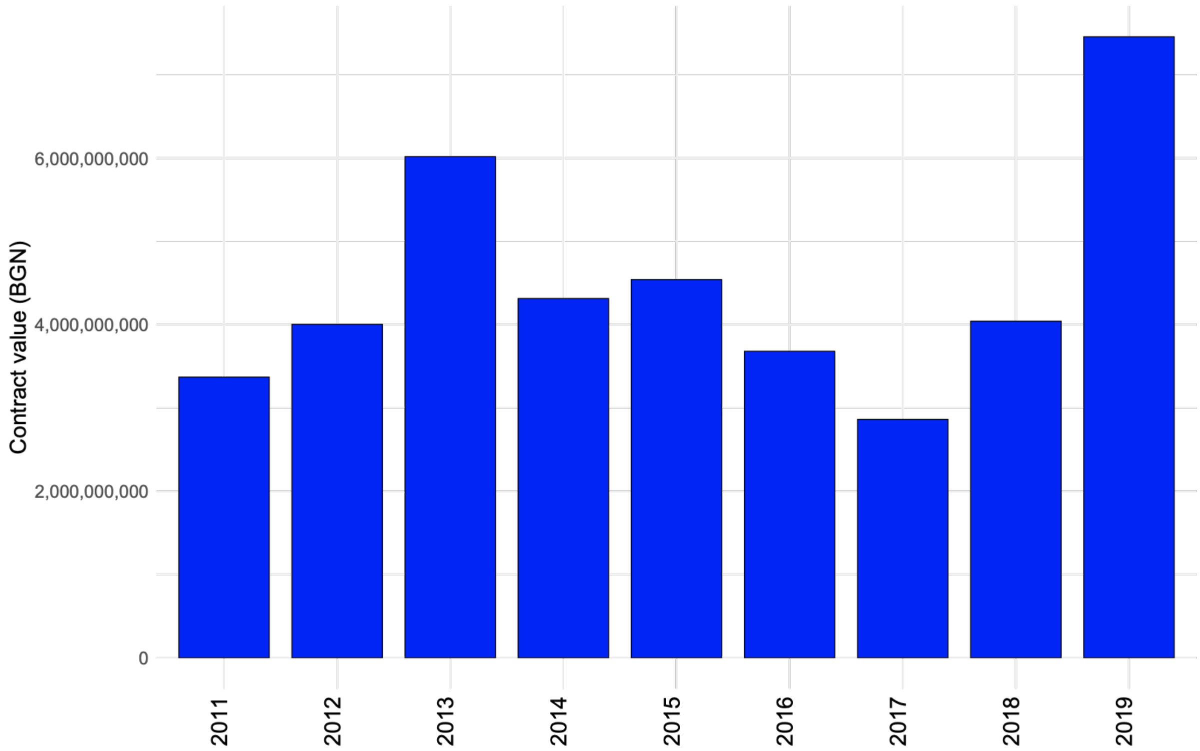
Figure 1.1: Annual number of observations, Bulgaria, 2011–2019



The total value of contracts awarded per year reveals a contrasting picture (Figure 1.2). The biggest total contract value was awarded in 2013–2015 and then in 2019, with the value being largely disconnected from the number of contracts (please note that the EU's budget cycle ended in 2013 with the 2014–2015 period available for spending hitherto unspent funds).

[28] Note that rows that do not have information on a concluded contract but only on lots can be either unawarded (cancelled or not yet awarded) or one awarded together with other lots, hence it stays as a freestanding lot, while another row represents the concluded contract covering it.

Figure 1.2: Total contract value per year, Bulgaria, 2011–2019



Annex 2: Processed publication types

List of publication types downloaded and processed - AOP

Обявление за възложена поръчка
ОБЯВЛЕНИЕ ЗА ВЪЗЛОЖЕНА ПОРЪЧКА
ОБЯВЛЕНИЕ ЗА ВЪЗЛОЖЕНА ПОРЪЧКА
ОБЯВЛЕНИЕ ЗА ВЪЗЛОЖЕНА ПОРЪЧКА В ОБЛАСТТА НА ОТБРАНАТА И СИГУРНОСТТА
Обявление за възложена поръчка - комунални услуги
ОБЯВЛЕНИЕ ЗА ВЪЗЛОЖЕНА ПОРЪЧКА - СПЕЦИАЛНИ СЕКТОРИ
ОБЯВЛЕНИЕ ЗА МАЛКА ОБЩЕСТВЕНА ПОРЪЧКА
РЕШЕНИЕ
ОБЯВЛЕНИЕ ЗА КОНКУРС ЗА ПРОЕКТ
ОБЯВЛЕНИЕ ЗА ОБЩЕСТВЕНА ПОРЪЧКА
ОБЯВЛЕНИЕ ЗА ОБЩЕСТВЕНА ПОРЪЧКА ОТ ВЪЗЛОЖИТЕЛ ПО ЧЛ. 7, Т. 5 ИЛИ 6 ОТ ЗОП
Обявление за поръчка
ОБЯВЛЕНИЕ ЗА ПОРЪЧКА
ОБЯВЛЕНИЕ ЗА ПОРЪЧКА
ОБЯВЛЕНИЕ ЗА ПОРЪЧКА В ОБЛАСТТА НА ОТБРАНАТА И СИГУРНОСТТА
Обявление за поръчка - комунални услуги
ОБЯВЛЕНИЕ ЗА ПОРЪЧКА - СПЕЦИАЛНИ СЕКТОРИ
ОБЯВЛЕНИЕ ЗА ПОРЪЧКА — СПЕЦИАЛНИ СЕКТОРИ
Обявление за приключване на договор за обществена поръчка
ИНФОРМАЦИЯ ЗА ИЗПЪЛНЕНИЕТО НА ДОГОВОР ЗА ОБЩЕСТВЕНА
ПОРЪЧКА
ИНФОРМАЦИЯ ЗА ПРОВЕДЕН КОНКУРС ЗА ПРОЕКТ
ИНФОРМАЦИЯ ЗА СКЛЮЧЕН ДОГОВОР
ИНФОРМАЦИЯ ЗА СКЛЮЧЕН ДОГОВОР ЗА МАЛКА ОБЩЕСТВЕНА ПОРЪЧКА
ИНФОРМАЦИЯ ЗА СКЛЮЧЕН ДОГОВОР ОТ ВЪЗЛОЖИТЕЛ ПО ЧЛ. 7, Т. 5 ИЛИ 6 ОТ ЗОП
Решение за откриване на процедура
ИНФОРМАЦИЯ ЗА ХОДА НА ПРОЦЕДУРАТА ПРИ ПРОИЗВОДСТВО ПО ОБЖАЛВАНЕ
Информация при производство по обжалване
КВАЛИФИКАЦИОННА СИСТЕМА — СПЕЦИАЛНИ СЕКТОРИ
КВАЛИФИКАЦИОННА СИСТЕМА — СПЕЦИАЛНИ СЕКТОРИ
ОБЯВЛЕНИЕ ЗА ДОБРОВОЛНА ПРОЗРАЧНОСТ EX ANTE
ОБЯВЛЕНИЕ ЗА СИСТЕМА ЗА ПРЕДВАРИТЕЛЕН ПОДБОР ОТ ВЪЗЛОЖИТЕЛ ПО ЧЛ. 7, Т. 5 ИЛИ 6 ОТ ЗОП
РЕЗУЛТАТИ ОТ КОНКУРС ЗА ПРОЕКТ
Социални и други специфични услуги - обществени поръчки

List of publication types downloaded and processed - EOP

Decision for starting a tendering procedure
Bid announcement for collecting of offers
F01 - Prior information notice
[str_Enum_publicationformtype_bgf02contractnotice]
F02 - Contract notice
[str_Enum_publicationformtype_bgf05contractnoticeutilities]
F05 - Contract notice – utilities
F17 - Contract notice for contracts in the field of defence and security
Contract award notice for a public procurement with value under art. 20, paragraph 3 or paragraph 7 of the public procurement law.
F03 - Contract award notice
[str_Enum_publicationformtype_bgf03contractawardnotice]
[str_Enum_publicationformtype_bgf06contractawardnoticeutilities]
F06 - Contract award notice – utilities
F18 - Contract award notice for contracts in the field of defence and security
F14 - Notice for changes or additional information
Notice for changes
Corrigendum (ZOP)
[str_Enum_publicationformtype_bg03noticeonfinishedexpiredawardcontract]
[str_Enum_publicationformtype_bg07invitationtocertainpersons]
[str_Enum_publicationformtype_bg09contractawardnoticeinvitation]
F21 - Social and other specific services – public contracts
F15 - Voluntary ex ante transparency notice
F04 - Periodic indicative notice – utilities
F12 - Design contest notice
F07 - Qualification system – utilities
F13 - Results of design contest
F16 - Prior information notice for contracts in the field of defence and security
F19 - Subcontract notice
F20 - Modification notice
F22 - Social and other specific services - utilities
Bulgaria F02 - Contract notice
Bulgaria F03 - Contract award notice
Bulgaria F05 - Contract award notice (utilities)
Bulgaria F06 - Contract notice (utilities)

Annex 3: Descriptive statistics of all variables used in the public procurement data analysis

	Unique (#)	Missing (%)	Mean	SD	Min	Median	Max
year	17	0	2013.4	3.8	2006.0	2013.0	2022.0
bid_digiwhist_price	84071	10	228419.0	3173335.0	99.0	26757.0	1101918138.0
bid_price	92115	11	446418.0	6239070.5	194.0	51750.0	2155722123.0
lot_bidscount	98	2	5.3	20.0	0.0	2.0	996.0
lot_electronicbidscount	11	84	0.1	0.7	0.0	0.0	9.0
lot_estimatedprice	20837	78	660808.9	11467812.4	200.0	79161.0	2155722123.0
lot_row_nr	1142	56	28.9	189.3	0.0	3.0	21105.0
lot_smebidscount	51	78	2.5	7.2	0.0	1.0	996.0
tender_digiwhist_price	67122	6	521983.3	4184994.7	100.0	70247.0	1101918138.0
tender_estimatedprice	24962	53	1541779.9	8623756.8	200.0	210000.0	1024330000.0
tender_finalprice	65706	9	1000515.9	8212798.9	195.0	133390.0	2155722123.0
tender_lotscount	398	0	34.9	117.3	1.0	3.0	1343.0
tender_recordedbidscount	20	0	1.1	0.9	1.0	1.0	35.0
framework_filter	1	0	1.0	0.0	1.0	1.0	1.0
bid_priceUsd	138535	11	653095.3	8999528.8	278.9	75951.6	3086001969.6
lot_estimatedpriceUsd	25610	78	947956.2	16556686.4	284.6	114523.2	3086001969.6
tender_estimatedpriceUsd	33580	54	2212616.0	12446626.0	284.6	307833.5	1466369140.9
tender_finalpriceUsd	83719	9	1461955.3	11892622.5	283.2	196541.5	3086001969.6
singleb	3	2	0.4	0.5	0.0	0.0	1.0
corr_proc	3	0	0.5	0.7	0.0	0.0	2.0
submission_period	109	33	33.6	11.2	0.0	32.0	277.0

	Unique (#)	Missing (%)	Mean	SD	Min	Median	Max
decision_period	367	51	74.1	54.8	0.0	61.0	365.0
corr_decp	3	0	1.5	0.8	0.0	2.0	2.0
filter_ok	1	0	1.0	0.0	1.0	1.0	1.0
market_id	46	0	45.4	23.5	3.0	42.0	99.0
ppp	16	0	0.7	0.0	0.6	0.7	0.7
ca_contract_value	138963	11	304486.0	4291432.2	128.3	35244.0	1489343245.8
ca_contract_value10	11	11	5.5	2.9	1.0	5.5	10.0
submp	108	33	33.7	11.2	1.0	32.0	277.0
submp10	11	0	36.3	44.0	1.0	8.0	99.0
corr_submp	3	0	3.1	4.1	0.0	0.0	9.0
decp	366	37	72.1	52.6	1.0	59.0	365.0
decp10	11	37	5.5	2.9	1.0	5.0	10.0
nocft	2	0	0.3	0.5	0.0	0.0	1.0
sec_score	19	100	65.0	14.4	44.2	59.1	88.6
fsuppl	3	69	0.0	0.1	0.0	0.0	1.0
taxhav	3	0	9.0	0.6	0.0	9.0	9.0
taxhav2	3	0	0.0	0.1	0.0	0.0	2.0
w_yam	95453	0	2288338.3	11574006.6	0.0	96393.3	1489343245.8
proa_w_yam	118489	0	697077.4	5767128.9	0.0	49829.9	1489343245.8
w_ycsh	42525	8	0.8	0.4	0.0	1.0	1.0
w_mycsh	10504	8	0.8	0.3	0.0	1.0	1.0

w_ynrc	120	0	13.0	40.3	1.0	2.0	495.0	
proa_ynrc	191	0	58.6	140.7	1.0	12.0	1146.0	
filter_wy	2	0	0.6	0.5	0.0	1.0	1.0	
n	1879	0	90.8	208.8	1.0	11.0	1879.0	
filter_w	2	0	0.5	0.5	0.0	1.0	1.0	
filter_wproa	2	0	0.7	0.4	0.0	1.0	1.0	
filter_wproay	2	0	0.8	0.4	0.0	1.0	1.0	
w_ycsh4	26161	71	0.4	0.4	0.0	0.2	1.0	
proa_yam	42256	0	14898275.3	68570355.7	0.0	740990.2	1735521845.5	
proa_ycsh	116109	5	0.3	0.4	0.0	0.1	1.0	
proa_mycsh	18726	5	0.5	0.3	0.0	0.5	1.0	
filter_proay	2	0	0.2	0.4	0.0	0.0	1.0	
filter_proa	2	0	0.2	0.4	0.0	0.0	1.0	
proa_nrc	264	0	180.6	350.2	1.0	27.0	1879.0	
proa_ycsh4	90519	32	0.1	0.2	0.0	0.0	1.0	
proa_ycsh9	65621	47	0.1	0.2	0.0	0.0	1.0	
MAD	236	69	0.0	0.0	0.0	0.0	0.1	
corr_ben	4	0	6.6	3.6	0.0	9.0	9.0	
ben	11	0	69.7	43.4	1.0	99.0	99.0	
submp25	26	0	41.3	40.8	1.0	19.0	99.0	
corr_proc2	3	0	0.2	0.4	0.0	0.0	1.0	
corr_decp2	3	0	0.7	0.4	0.0	1.0	1.0	

proa_yam	42256	0	14898275.3	68570355.7	0.0	740990.2	1735521845.5	
proa_ycsh	116109	5	0.3	0.4	0.0	0.1	1.0	
proa_mycsh	18726	5	0.5	0.3	0.0	0.5	1.0	
filter_proay	2	0	0.2	0.4	0.0	0.0	1.0	
filter_proa	2	0	0.2	0.4	0.0	0.0	1.0	
proa_nrc	264	0	180.6	350.2	1.0	27.0	1879.0	
proa_ycsh4	90519	32	0.1	0.2	0.0	0.0	1.0	
proa_ycsh9	65621	47	0.1	0.2	0.0	0.0	1.0	
MAD	236	69	0.0	0.0	0.0	0.0	0.1	
corr_ben	4	0	6.6	3.6	0.0	9.0	9.0	
ben	11	0	69.7	43.4	1.0	99.0	99.0	
submp25	26	0	41.3	40.8	1.0	19.0	99.0	
corr_proc2	3	0	0.2	0.4	0.0	0.0	1.0	
corr_decp2	3	0	0.7	0.4	0.0	1.0	1.0	
corr_submp2	3	33	0.2	0.4	0.0	0.0	1.0	
cri	96005	0	0.4	0.3	0.0	0.3	1.0	
covid_ted_product	2	0	0.0	0.0	0.0	0.0	1.0	
covid_decree_products	2	0	0.0	0.1	0.0	0.0	1.0	
hh_market	2	0	0.2	0.4	0.0	0.0	1.0	
hh_contract	2	0	0.0	0.1	0.0	0.0	1.0	
product_groups	3	0	1.2	0.4	1.0	1.0	3.0	

Annex 4: Definition of procedure types

Risk value	Procedure type
0	Договаряне без предварително обявление
0	Договаряне с обявление
0	Договаряне с предварителна покана за участие
0	Договаряне с публикуване на обявление за поръчка
0	Открита
0	Открита процедура
0	Процедура на договаряне с предварителна покана за участие в състезателна процедура
0	по реда на ЗОП Договаряне с обявление
0	по реда на ЗОП Открита процедура
0	по реда на НВМОП Договаряне с покана
0	pt_negotiated_with_prior_call
0	pt_open
0	pt_negotiated_with_publication_contract_notice
0	по реда на НВМОП Открит конкурс
0.5	Възлагане на поръчка без предварително публикуване на обявление за поръчка в Официален вестник на Европейския съюз (в случаите, изброени в букви к) и л) от приложение Г1)
0.5	Договаряне
0.5	Договаряне без публикуване на обявление за поръчка
0.5	Договаряне с обявяване на конкурентно възлагане на поръчка
0.5	Договаряне с покана
0.5	Открит конкурс
0.5	По реда на ЗОП
0.5	Процедура на договаряне с предварителна покана за участие в състезателна процедура
0.5	Публично състезание
0.5	Ускорена процедура на договаряне

Risk value	Procedure type
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП Чл. 53, ал. 1, т.10 от НВМОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.1 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.11 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.3 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.4 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.6 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.8 от ЗОП
0.5	III. Правно основание попълва се от възложител по чл.7, т.1-4 ЗОП чл. 90 ал. 1, т.1 от ЗОП
0.5	pt_competitive_negotiation
0.5	NEGOTIATED
1	Възлагане на поръчка без предварително публикуване на обявление (в случаите, изброени в букви к) и л) от приложение Г)
1	Възлагане на поръчка без предварително публикуване на обявление за поръчка в Официален вестник на Европейския съюз в случаите, изброени по-долу (моля, попълнете приложение Г1)
1	Възлагане на поръчка без предварително публикуване на обявление за поръчка в Официален вестник на Европейския съюз в случаите, изброени по-долу (моля, попълнете приложение Г2)
1	Договаряне без обявление
1	Договаряне без обявяване на конкурентно възлагане на поръчка
1	Договаряне без предварително обявление
1	Договаряне без предварително публикуване на обявление за поръчка
1	Ограничена
1	по реда на ЗОП Договаряне без обявление
1	Accelerated restricted

Risk value	Procedure type
1	pt_award_contract_without_call
1	pt_innovation_partnership
1	f18_pt_negotiated_without_publication_contract_notice
1	f06_pt_negotiated_without_competition
1	pt_restricted
1	Private

Annex 5: Matching public procurement data to the BVD data

We first identify consortium purchases in the dataset based on several rules: (a) suppliers tagged with дззд, консорциум (consortium), обединение (association); (b) using keywords in the supplier name field '- с учас/ци в обедине/то-', 'участници в обединението са', 'със съдружници', 'с партньори'; (c) if the supplier name field contains more than one legal form. We then use the HERE API (https://developer.here.com/) to standardize the locations of both public organizations and private firms. We also perform several cleaning steps for each of the public procurement and BVD data organization's name fields. In this step, we try to standardize the organization's name as much as possible by extracting any BVD IDs that remain in the name field. For private firms, the cleaning steps differ depending on whether the winner is a consortium or a private organization. We also strip the name field of all the weird symbols, non-unicode characters and phrases that do not refer to the actual winning organization. We then carry forward the source ID within the clean name-city pairs. For buyers, we were able to successfully carry forward the source ID for 68,779 contracts and decrease the missing rate by 32.5 percent. As for suppliers, we managed to carry forward the source ID for 83,858 contracts and decreased the missing rate by 39.6 percent. We carry forward the source ID only if the name-city pair contains one unique source ID. However, if the name-city pair contained conflicting source IDs, we use all the IDs found within the name-city pair and match them to the BVD dataset. This way incorrectly scraped IDs will not get matched to the BVD dataset but only the correct IDs will be successfully matched.

We first match the scraped source IDs to the national ID number in the BVD dataset. After cleaning the organization name variables and standardizing the city variable in the BVD data, we match the ones that do not get matched using the clean name-city pairs. Finally, we match the remaining non-matches using the clean name only. We present the results of the matching in Table 5.1. Through this process we managed to match 77 percent of the contracts for the public organizations and 95.2 percent of the contracts for the suppliers.

Table 4.1: Results of matching the public procurement data to the BVD dataset

Stage 1: Matching based on the source ID				
Public organizations			Suppliers	
	Contracts	%	Contracts	%
Total contracts[29]	173,199	82.15	191,559	90.51
Matched	80,192	46.30	176,728	92.26
Unmatched	93,007	53.70	14,831	7.74
Stage 2: Matching based on the clean organization name and city				
Public organizations			Suppliers	
	Contracts	%	Contracts	%
Starting total[30]	131,105	62.19	34,915	16.50
Matched	75,074	57.26	9,355	26.79
Stage 3: Matching based on the clean organization name				
Public organizations			Suppliers	
	Contracts	%	Contracts	%
Starting total[31]	56,031	26.6	25,560	12.1
Matched	7,060	12.6	15,506	60.7
Total matched	162,326	77.0	201,589	95.2

[29] Total contracts with non-missing source IDs

[30] Contains all contracts with missing source IDs and non-matches from Stage 1.

[31] Contains all non-matches from Stage 2.

Annex 6: Politically connected companies

- We observed 4,566 politically connected firms in the Orbis firm data. All politically connected firms are (co-)owned or managed by a PEP who has a political post allowing her/him to influence policy and regulation governing businesses.
- First-tier politically connected firms are (co-)owned by PEPs with a high political post in the executive or legislative in the national government that allows them to directly influence policy.[a]
- Firms with political connection to the executive implementing the law are (co-)owned by PEPs who are part of the government including heads of the cabinet, ministers, deputy ministers, secretary generals, commissioners (high positions), or have leading positions in the public administration including chief experts and heads of departments.[b]
- Firms with political connection to legislative policy makers are (co-)owned by PEPs who are members of the national or European parliaments (high positions) or members of the governing bodies of a political party.
- Firms with political connection to local governments are (co-)owned by PEPs who are mayors, deputy, mayors, (deputy) district governors, chief architects (all high positions), and municipal councilors.
- Firms with political connection to SOEs are (co-)owned by PEPs who are (deputy) directors or members of governing boards of SOEs, including regulating government agencies.
- Other politically connected firms are (co-)owned by PEPs with political positions at nongovernmental organizations (NGOs), state hospitals, or universities and working at courts (judges, prosecutors, head of administration).

Note: a. The high, influential political positions include Head of Minister Cabinet, Secretary General, Minister, Deputy Minister, Commissioners, and Members of the National or European Parliaments. Such positions at the following government bodies with weak political importance are not included: courts, customs, state enterprises, district administration, foreign or national military divisions, municipalities, political party, prosecution, embassy or consulate, NGOs, state hospitals, or universities.
b. Political positions at NGOs, state hospitals, or universities have been excluded for the executive and legislative connected firms.