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A comprehensive review of objective corruption proxies in public procurement: risky actors, transactions, and vehicles of rent extraction[4]

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Abstract

Corruption is ostensibly difficult to measure, especially when it is unclear which form of corruption is captured, which part of the corrupt deal is visible in the data, and how different proxies relate to each other. Due to the emergence of innovations in measuring corruption in public procurement, this paper can provide a comprehensive review of quantitative corruption proxies, conceptualise how different indicators capture different aspects of corruption, and identify gaps in the measurement landscape. Institutionalised, well-established corruption in government contracting aims to bypass fair and open competition in order to allocate contracts to companies belonging to the corrupt group. This requires at least i) corrupt *transactions* allowing for rent generation, ii) *particularistic relations* underpinning collective action of corrupt groups; iii) *organisations* enabling rent allocation (public organisations); and iv) organisations extracting corrupt rents (private companies). These four requirements of corrupt contracting serve as a framework for the review. We find that there is a surprisingly wide array of indicators validated in particular contexts, leaving generalisability unclear. It is also suggested that the academic literature has largely been preoccupied with one or the other type of corruption proxies such as personal connections without recognising their complementarities. Given the clandestine and often complex character of corrupt deals, a comprehensive measurement approach is advocated where each indicator sheds light on different aspects of the same corrupt phenomena.

1. Introduction

Corruption, favouritism, clientelism, and similar concepts have long featured centrally in academic as well as policy debates on good government, development, and security. However, they are ostensibly difficult to measure, partially due to conceptual disagreements, but to a much greater extent due to the difficulty of accessing the necessary data. Hence, for a long time perception indicators and qualitative studies represented the only source of evidence on corruption. However, the recent years have seen a whole new generation of indicators emerging in data rich areas. Government activities which are subject to extensive transparency legislation and concern large amounts of public resources are increasingly amenable for building corruption proxies based on linked administrative data. Examples emerge in public procurement, legislation and regulation, public asset and license auctions, and civil service human resources. Among the data rich areas of government activities, public procurement stands out by accounting for roughly one third of government spending, very high perceived corruption prevalence, and a vibrant innovative research environment turning out many new corruption proxies (OECD 2007, 2013).

By implication, the time is ready for the paper to compile a comprehensive review of corruption proxies in the domain of public procurement, to systematically organise them in order to identify evidence gaps, and to assess indicator quality and scope for application. This review paper sets out to do just this while also calling for further work, in particular to apply and adapt promising corruption risk indicators to new problems and countries. By carefully synthesizing measurement innovations and matching them to a simple theory of corrupt exchanges, the authors also hope to inspire scholars of other domains where data is left unharnessed by quantitative researchers. Further work is supported by providing the links to open datasets which are necessary for calculating and testing the reviewed indicators. Most data can be found for European countries at digiwhist.eu/resources/data.

The style of this review is highly polemical, reflecting the inherent challenges of devising reliable and valid proxies of a phenomenon deliberately hidden by its actors. No single indicator is sufficiently valid even within a set context, let alone used for cross-country comparisons. It is advocated that proxies are best used in conjunction rather than in isolation and indicators need to be carefully matched to the specific research and policy problem. The key contribution of this paper is that it thoroughly catalogues the wealth of corruption proxies available while also offering guidance on how to assess and combine them.

2. Conceptual frame

The term corruption is used to cover diverse phenomena in many contexts which differ in the prevailing norms of good conduct. Hence, many characterisations of corruption are normatively charged and context-dependent (Johnston 1996). Probably the most common definition of corruption - "the misuse of public office for private gain" - (Rose-Ackerman 1978) understands corruption within a bureaucratic context and associates corruption with bribery of public officials. The problem with this definition, on the one hand, is that Weberian bureaucracy and the underlying rational-legal order may not be present in many contexts at all; on the other hand, it is also inadequate to capture corruption in public positions with high degrees of discretion such as members of parliament (Warren 2003) or public procurement decision makers.

Departing from such definitions, this discussion paper sets out a corruption concept tightly matched to the domain of public procurement and building on the literature defining corruption in conjunction with open and impartial access to public resources, that is understanding corruption fundamentally as a problem of power distribution within society and constraints on exercising political power (Mungiu-Pippidi 2006; North, Wallis, and Weingast 2009; Rothstein and Teorell 2008). In addition, our focus is predominantly on institutionalised and recurrent forms of corruption. Such corrupt exchanges are central to our review not only because they are capable of inflicting long-lasting and substantial costs on societies, but also because the markers they leave in large administrative datasets are easier to measure than isolated instances of corruption. Hence,

> *in public procurement, institutionalised grand corruption refers to the allocation and performance of public contracts by bending universalistic rules of open and fair access to government contracts in order to benefit a closed network while denying access to all others.*

The goal of such corruption is to steer the contract to the favoured bidder without detection in an institutionalised and recurrent fashion (World Bank 2009). This can be done in a number of ways, including avoiding competition (e.g., unjustified sole sourcing or direct contract awards), favouring a certain bidder (e.g. tailoring specifications to a particular company), and sharing insider information (Fazekas, Tóth, and King 2016). Such corruption may involve bribery and transfers of large cash amounts as kickbacks, but it is more typically conducted through broker firms, subcontracts, offshore companies, and bogus consultancy contracts. By implication, not everything designated as corruption in this paper represents illegal activity as defined by the law in a given country.

This straightforward corruption definition implies four key elements of any corrupt transaction in public procurement:

- The awarded contract;
- The particularistic tie;
- The awarding body; and
- The winning bidder.

The awarded contract represents the primary source of rents to be extracted and distributed. Assuming that corrupt firms are not more productive than their non-corrupt peers, contracts

have to be overpriced or the delivered quantity or quality lower than specified in order to generate the extra income for the corrupt network.

The particularistic tie serves as the backbone of collective action by the corrupt group spanning through the public and private spheres, often making and enforcing complex informal deals. Such ties establish trust as well as means of informal control and oversight underpinning within-group coordination. Particularistic ties can be of diverse nature ranging from personal relationships such as kinship to more formal connections established through party donations or formal employment (i.e. revolving door). Note that particularistic ties may or may not involve bribery and kick-backs symptomatic of the classical understanding of corruption. Our broader definition implies that there is a broader range of payback mechanisms than the use of informal monetary payments.

The awarding body, which is typically a public sector organisation, manages the tendering process starting from setting the specifications through assessing bidders to monitoring contract implementation. Thus, it is essential to tightly control it in order to award the contract to the bidder belonging to the corrupt network. Corrupt control of the tendering process can be driven by political as well as bureaucratic actors depending on the power distribution within the network, however, bureaucrats administering the tender always have to be involved as formally they manage the tender. As high-level corruption in public procurement is frequently linked to gaining and maintaining political power, it is suggested that politicisation of permanent bureaucracies represent one key sign of informal groups overriding formal hierarchies (della Porta and Vannucci 1999).

The winning bidders or suppliers represent the main instrument for extracting and distributing corrupt rents. As long as their production costs are lower than the contract value, they are able to generate the income which can be allocated to the members of the corrupt network. Passing on the proceeds of corruption can take various forms such as directly allocating the owners' profit, using subcontracts, consultancy arrangements, or hefty wages to employees.

The key innovation of our measurement approach is that each of the four components of the corrupt exchange gives rise to a set of indicators which can be used in isolation or in conjunction. Figure 1 graphically summarizes the conceptual elements and the corresponding variable groups. The indicators proposed here only indicate the risk of corruption; in other words they are proxy indicators indirectly pointing at the underlying corrupt exchanges (Johnson and Mason 2013). Crucially, the indicators are tailored to the domain of public procurement; however, some of them may be indicative of corruption more broadly. In particular, corruption proxies of organisational behaviour (public bodies and suppliers) may also point at broader issues of corruption and bad governance.

FIGURE 1. OVERVIEW OF THE CORRUPT EXCHANGE AND INDICATOR GROUPS
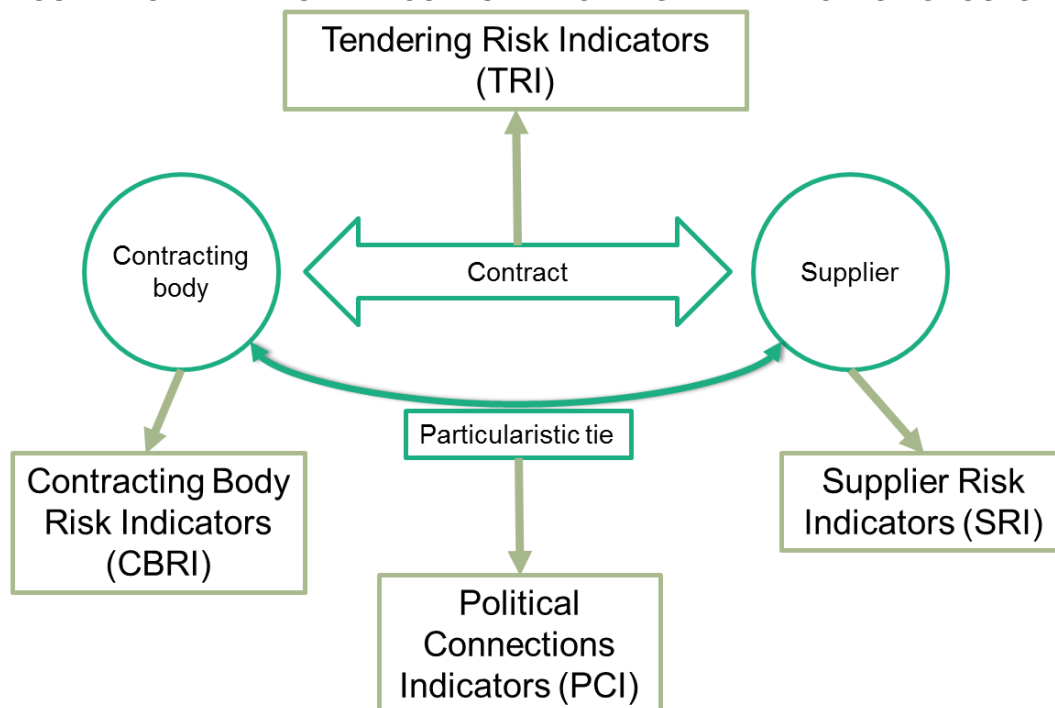
Note: green denotes components of the corrupt scheme; grey marks the indicator groups

Tendering Risk Indicators (TRI) signal corrupt manipulation of the tendering process on the level of tenders in order to generate rents and allocate them to the connected companies. A particularly widely quoted example is the tailoring of tender conditions to fit a single company on an otherwise competitive market. Political Connections Indicators (PCI) provide cues on the personal connections between bidder owners/managers and political office holders (kinship, friendship, professional, etc.) directly or indirectly able to influence the public procurement process. Such particularistic ties are also necessary for governing corrupt deals. Supplier Risk Indicators (SRI) signal the use of winner companies as vehicles of rent extraction and the distribution and hiding of assets which are indispensable for rewarding all the participants of the corrupt deal and avoiding detection. Contracting Body Risk Indicators (CBRI) capture the weaknesses of formal bureaucratic structures designed to shield contracting bodies from pressures to favour connected bidders which is indispensable for implementing and managing corrupt rent allocation (i.e. implementing TRI-type corrupt tenders). These indicators jointly capture the complete process of generating, allocating and distributing corrupt rents from government contracts, they don't specifically capture how favours are returned and kick-backs paid. These processes are captured as long as they are part of the procurement system, however, if they take the form of broader schemes such as political party financing or gaining control of the media, they are excluded from this analysis. This is essential for narrowing down the scope of the review.

Subsequently, we use a uniform set of benchmarks against which various corruption risk indicators are assessed. While indicators might be very different, the requirements of academic and policy users are by and large similar, making our assessment exercise comparable across indicators. We expect that indicators are:

- **objective:** they are based on factual data non-mediated by stakeholder's perceptions, judgements or self-reported experiences;

- **de facto:** Indicators describe actual behaviour or events in contrast to legal prescriptions or expectations;

- **micro-level:** they are defined on the level of actors of corrupt exchanges (e.g. companies) or the transactions among them (i.e. contracts). They can nevertheless be aggregated at higher levels.

- **internationally comparable:** while defined on the micro-level, indicators should be comparable across countries or regions, due the same underlying theoretical concepts and measurement approach, as long as the same corrupt behaviour exists across countries;

- **comprehensive:** they adequately capture corruption risks in a wide set of organisations performing comparable tasks; and

- **time-series:** indicators are ideally measured and can be compared over time for at least 5-10 years.

If an indicator fulfils all of the above criteria it is warranted that it is actionable and sensitive to changes in the underlying behaviours which are essential for using them in academic research and policy decisions (Knack, Kugler, and Manning 2003).

3. Data requirement

Using objective indicators to measure corruption risks in government contracting demands widely available, high quality administrative data on public procurement tenders and contracts, bidding companies, awarding public organizations and political office holders. However, countries differ greatly with respect to the availability and connectivity of these datasets, which ultimately affects the depth of corruption risk analysis. The data template used by DIGIWHIST - the large-scale EU-funded research project this review is part of - supports corruption measurement by organising and linking the above four complex datasets. The DIGIWHIST data template then also serves the basis for collecting and republishing publicly available and sufficiently well-structured databases pertaining to corruption measurement in Europe.

In public procurement datasets, the most widely used level of observation is the contract, as it represents the primary object of corrupt transactions as well as the main level of administrative data collection. Contract-level data primarily comes from public procurement announcements which are placed in central advertising portals. Public organizations are typically obliged to publish a call for tenders and a contract award announcement for every regulated government contract[5]. These include all general information on how competitive the bidding procedure was, and the outcome of each procedure. However, detailed information on the contracting parties is typically not disclosed with the tender information. Therefore, data on public organizations and companies need to be linked to public procurement contracts from other sources. While detailed company data on company location, financial performance, owners, etc. is only available through private data providers[6]; public organisations' registry and budget data can be collected from public sources.[7] Connecting these datasets to government contracts makes it possible to gain insights into the companies winning government contracts, and how public organizations differ according to their contracting activities. The last part of a comprehensive linked database follows directly from our proposed measurement framework: in order to govern corrupt rent extraction, a particularistic tie must exist between the favoured supplier and the contracting body. Therefore, data on political officeholders is also connected to each company. Table 1 summarizes the types of data used for developing objective corruption proxies. The full description of databases can be found at http://digiwhist.eu/resources/research-and-policy-papers/ and the databases collected and linked by DIGIWHIST enabling our measurement approach can be found at http://digiwhist.eu/resources/data.

As it was already mentioned, the smallest unit of observation used in our measurement approach is a contract, as all other types of data can be connected to it. Nevertheless, aggregated measures are also often used: both company and public organization related risks imply indicators at the organisational level over time.

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[5] Note, that there are several other types of announcements in use, e.g. procurement plans, modification announcements etc., however, the most widely available ones are the call for tender and contract award documents.

[6] Although opencorporates.com offers a unique open dataset on companies, it does not have financial and ownership information.

[7] In general, data on all central administration bodies, autonomous agencies, regional, provincial and municipal bodies, state-owned enterprises and publicly-funded organizations is connected to government contracts.

TABLE 1: SUMMARY OF DATABASES USED FOR CORRUPTION RISK ESTIMATION

Data type	Description and example variables
Public procurement	**Call for tender related information:** procedure type, product code, bidding period length, bidder limitation, estimated value, type of the contract, documentation fee, buyer, award criteria
	Contract award related information: number of bids received, bidder and winner company related information (bid prices, location), final contract value, award signature date
Company data	**Registry information:** company name, location, legal form, date of incorporation, number of employees etc.
	Financial information: annual turnover, profit rate, return on assets, material costs, personnel costs, taxes, EBITDA
	Ownership information: number of recorded shareholders, shareholder's name, shareholder's type (legal entity, individual etc.), shareholder's location, shareholder's direct and total shares
	Manager information: number of directors, name of company directors, position of company directors, appointment and resignation date of directors, gender, date of birth, shareholder status
Public organization data	**Registry data:** name, ID, location, activity type, contact information,
	Budget data: annual budget figures, currency, classification of the budget item (IFRS)
Public officials data	Name, contracting authority, position, start and end date, political affiliation

4. Indicator groups in detail

4.1 Tendering Risk indicators

Tendering risk indicators capture all those micro-level aspects of public procurement tenders and contract implementation which signal corrupt manipulation of the procurement process in order to generate rents and allocate them to the connected companies.

A small but innovative academic and policy literature has emerged in the last decade or so, on the one hand establishing the validity of individual corruption proxies; on the other, providing a rich repository of potential indicators based on practitioners' and experts' views. A selective set of high-quality research papers using directly observable, hard indicators of potentially corrupt behaviour is displayed in Table 2. These studies look into tendering corruption risks in various contexts such as elections and high-level politics or welfare services and redistributive politics. For example, Olken (2007) uses independent engineers to review road projects and calculates the amount and value of missing inputs to indicate corruption during contract implementation. Another approach to assess the amount of missing procurement outputs in infrastructure is proposed by Golden & Picci (2005) who look into the difference between the stock of infrastructure and cumulative public spending on it using two independent data sources. Other authors use indicators characterising the bidding process on the micro-level: the use of exceptional procedure types (Auriol, Flochel, and Straub 2011) or negotiated procedures (Chong, Klien, and Saussier 2015), explicit scoring rules (Hyytinen, Lundberg, and Toivanen 2008) or single bidder auctions (Klasnja 2016).

TABLE 2. SUMMARY OF SELECTED ACADEMIC STUDIES USING OBJECTIVE TENDERING RISK INDICATORS

source	indicator used	Country	year	sector	potential for international comparison
(Auriol, Flochel, and Straub 2011)	Exceptional procedure type	Paraguay	2004-2007	general procurement	HIGH If procedure definitions can be aligned, international comparisons can be made widely
(Bandiera, Prat, and Valletti 2009)	Price differentials for standard goods purchased locally or through a national procurement agency	Italy	2000-2005	standardized goods (e.g. paper)	LOW Price data is not readily available in most countries, many countries don't have national procurement agencies, national procurement agencies are likely to be captured in many countries.
(Chong, Klien, and Saussier 2015)	Negotiated procedure type	EU	2008-2012	general procurement	HIGH If procedure definitions can be aligned, international comparisons can be made widely
(Coviello and Gagliarducci 2010)	Number of bidders Same firm awarded contracts recurrently Level of competition	Italy	2000-2005	general procurement	HIGH Number of bidders, recurrent contract award, and competitiveness of bids are available in many countries.
(Di Tella and Schargrodsky 2003)	Difference in prices of standardized products such as ethyl alcohol	Argentina	1996-1997	health care	MEDIUM Detailed product-level price and quantity information is not readily available across many countries, but can be collected.
(Fazekas and Kocsis 2015)	Composite risk score including elementary indices such as single bidding, or short advertisement period	EU	2009-2014	general procurement	HIGH If indicator definitions can be aligned, international comparisons can be made widely
(Golden and Picci 2005)	Ratio of physical stock of infrastructure to cumulative spending on infrastructure	Italy	1997	infrastructure	MEDIUM It is hard to compute comparable value of the stock of physical capital across countries different in the quality of infrastructure and geography.
(Hyytinen, Lundberg, and Toivanen 2008)	Number and type of invited firms Use of restricted procedure	Sweden	1990-1998	cleaning services	HIGH Both number of bidders and procedure types are readily available in many countries.
Klasnja (2015)	Single bidder auctions Non-open procedure types	Romania	2008-2012	general procurement	HIGH If procedure definitions and bidding conditions can be aligned, international comparisons can be made widely
(Olken 2006)	Difference between the quantity of in-kind benefits (rice) received according to official records and reported survey evidence	Indonesia	1998-1999	welfare spending	MEDIUM It is possible to design user surveys across a wide range of countries to track actual receipts, although it may be expensive.
(Olken 2007)	Differences between the officially reported and independently audited prices and quantities of road construction	Indonesia	2003-2004	infrastructure (roads)	LOW Auditing large numbers of projects by independent engineers is costly and unlikely to allow for cross-country comparisons.

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While the academic quality of these papers is uniformly high, their approach is not always replicable or feasible to deploy on multiple countries over long time-series. Many of them single out a narrow indicator which may or may not be the primary vehicle for corrupt rent extraction depending on the regulatory framework in place (Olken and Pande 2012). For example, corruption linked to exceptional procedure types may be easily stopped by simply removing the procedure from the procurement law, however it is unlikely that this alone would change the underlying corrupt phenomena much (Auriol, Flochel, and Straub 2011). In other words, valid tendering risk proxies need to be adapted to the local regulatory and market context and consider to what degree the different ways of corrupting the tendering process are substitutes or complementarities.

While most academic studies reviewed above focus on 1-2 narrowly defined indices, a number of policy reports instead provide a wide ranging overview of potential corrupt practices in procurement processes by and large capturing the experience and perceptions of practitioners and experts (OECD 2007; Transparency International 2006; World Bank 2007, 2009). While immensely useful for providing background for quantitative indicator building, the suggested practices and the implied indicators lack application and testing in large procurement datasets which could establish their validity. Some statistical testing of these indicators on large datasets has been done by academic researchers (Charron et al. 2016; Fazekas and Kocsis 2015; Fazekas, Tóth, and King 2016); while tests using small samples of known corrupt cases came to conflicting conclusions, underlying the importance of focusing on bidding outcomes rather than procedural appropriateness (Kenny and Musatova 2010; Pricewaterhouse Coopers 2013).

In order to lay the foundation for further work, Table 3 provides a succinct overview of easily replicable indicators whose validity was demonstrated in multiple countries; hence, these are the indicators which are potentially applicable across the globe. This indicator list is considerably narrower than the potentially relevant and testable indicators' list, on the one hand because indicators which have turned out to be invalid when tested in large public procurement datasets are excluded; on the other hand, because indicators which have been suggested by experts, but were never thoroughly tested are excluded. These promising indicators tested predominantly in European public procurement datasets should be calculated for other national public procurement databases in developed as well as developing economies in order to precisely define their scope of applicability. In addition, the large number of suggested, but never tested indicators should be subject to thorough validity tests using large-scale datasets as soon as they are available (note that many indicators suggested by experts and practitioners are not currently available in large scale datasets as they pertain to aspects of public tendering not yet digitized and/or released in public documents).

TABLE 3. SUMMARY OF CORRUPTION PROXIES CAPTURING TENDERING RISKS

phase	indicator name	indicator definition
submission	Single bidder contract[8]	0=more than one bid received 1=ONE bid received
	Call for tender not published in official journal	0=call for tender published in official journal 1=NO call for tenders published in official journal
	Procedure type	0 =open procedure 1=non-open procedure
	Length of eligibility criteria	number of characters of the eligibility criteria MINUS average number of characters of the given market's eligibility criteria
	Length of product description	number of characters of product description MINUS average number of characters in the given market
	Length of submission period	number of days between publication of call for tenders and submission deadline
	Relative price of tender documentation	price of tender documentation DIVIDED BY contract value
	Call for tenders modification	0=call for tenders NOT modified 1=call for tenders modified
assessment	Exclusion of all but one bid	0=at least two bids NOT excluded 1=all but one bid excluded
	Weight of non-price evaluation criteria	proportion of NON-price related evaluation criteria within all criteria
	Annulled procedure re-launched subsequently*	0=contract awarded in a NON-annulled procedure 1=contract awarded in procedure annulled, but re-launched
	Length of decision period	number of working days between submission deadline and announcing contract award
	Unit price	% deviation in the trice of standardized unit compared to private market price or lowest public procurement price
delivery	Contract modification	0=contract NOT modified during delivery 1=contract modified during delivery
	Contract lengthening	relative contract extension (days of extension/days of contract length)
	Contract value increase	relative contract price increase (change in contract value/original, contracted contract value)

* Combining annulations by the issuer and the courts
Source: adapted from (Fazekas, Tóth, and King 2016)

4.2 Political Connections Indicators

Personal connections between political office holders and private companies bidding for government contracts, political connections in short, are of diverse nature[9]: companies employing current or past political office holders or their kin or other trusted agents; public organizations may also employ former employees of corporations (revolving door); while there is also a wide range of brokers and intermediary corporate structures which establish personal links (Rajwani and Liedong 2015). The use of these different strategies of personal

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[8] The single bidder indicator is simultaneously an outcome of the submission phase and an input to the assessment phase.

[9] Note that no particular direction of influence is assumed: company to politics or the other way around.

connections and control very much depend on the threat of exposing corrupt dealings and the specificities of the country's legal framework (e.g. conflict of interest regulations) (Trapnell 2011).

As some of these types of personal connections are more difficult to measure than others, there is an inherent risk that the most important type is left out from the analysis. In addition, connections between political office holders and private companies can be established in a variety of other ways which are less linked to specific individuals rather to more institutionalised forms of connections such as political party finances (Fazekas and Cingolani 2016; OECD 2014) or lobbying (David-Barrett 2011). Again the use of these different channels of influence and the ways in which they are combined partially depend on the probability of exposure to the public or law enforcement agencies adding to measurement challenges.

Nevertheless, theoretically all of these different forms of political connections, personal or impersonal, direct or indirect, are expected to work in a similar way in terms of supporting the corrupt reward of companies through government contracts. Political connections in such an exchange of political favor for private gain represent a multitude of essential components: first, political ties represent a means of controlling and managing the transaction in an informal contract which is typically non-enforceable by courts. Second, they also serve as a vehicle for rent extraction when the political office-holder earns income from the companies receiving government contracts. Third, political connections can also support broader trust building and facilitate information sharing, especially when the corrupt network is large and benefits and costs of corruption are spread across the network.

Prior empirical literature looked at personal political connections or political influence established through political party donations (Table 4). Academic papers considered short as well as long term direct benefits to the connected companies (1-4 years) (Goldman, Rocholl, and So 2013; Luechinger and Moser 2014) while others considered ties either to specific individuals or parties as a whole (Akey 2013; Straub 2014). Most studies look at individual countries with only partially comparable research questions, data, and analytical tools. For example, in Brazil, companies' campaign contributions translate into additional contracts won worth 14 times more than the contributions (Boas, Hidalgo, and Richardson 2014), the same figure in the US is only 2.5 times (Bromberg 2014). Moreover, in the US the largest predictor of company procurement volume from before to after the 1994 change in the controlling majority of the House and the Senate is to which party the company was connected to (Goldman, Rocholl, and So 2013). Surprisingly, in Denmark which is one of the least corrupt countries of the world, direct family ties between companies and politicians increase company profitability, especially in sectors dependent on public demand, i.e. public procurement Amore and Bennedsen (2013). One study looks into within country variation and tries to link quality of institutions to the association between procurement income and political connections in Russia. It uses a unique database of all bank transfers leaked from the national bank to identify bogus transfers between companies clustering before elections (Mironov and Zhuravskaya 2012).

TABLE 4. SUMMARY OF SELECTED ACADEMIC STUDIES USING OBJECTIVE POLITICAL CONNECTIONS INDICATORS

source	indicator used	Country	year	sector	potential for international comparison
(Goldman, Rocholl, and So 2013)	Political office holders' position on company boards	USA	1990-2004	general procurement	HIGH Company contract volumes can be estimated in many countries and publicly listed companies' direct political connections can be traced relatively easily.
(Luechinger and Moser 2014)	Political connection of companies through board members	USA	20 years interval	Defence	MODERATE Availability and connectivity of government officials to company boards varies greatly among countries.
(Akey 2013)	Firm's connections to congressional candidates through campaign donations	USA	1998-2010	Not sector specific	LOW Firms' connectedness is based on recorded political campaign contribution, which is not available widely
(Straub 2014)	Firm's connections to political parties	UY	2004-2011	General procurement	HIGH Company contract volumes can be estimated in many countries and publicly listed companies political connections can be traced relatively easily.
(Boas, Hidalgo, and Richardson 2014)	Firm's political connections through campaign donations	BR	2004-2010	General procurement	LOW Firms' connectedness is based on recorded political campaign contribution, which is not available widely
(Bromberg 2014)	Firm's political connections through campaign donations	USA	2001-2006	General procurement	LOW Firms' connectedness is based on recorded political campaign contribution, which is not available widely
(Amore and Bennedsen 2013)	Firm's connections to political parties (directly or through family)	DK	2000-	General procurement	MODERATE Connecting elected politicians directly or especially indirectly (through his/her family members) to companies is often not feasible.
(Mironov and Zhuravskaya 2012)	Companies' illegal contribution to party finance before elections.	RU	1999-2000	General procurement	LOW Tracing illegal party financing directly is not possible
(Cingano and Pinotti 2013)	Political office holders' employment by companies	IT	1985-1997	General procurement	LOW Detailed employment data on companies is not available in general.

These studies show the varieties of political connections and the effects they can have on public procurement success. Hence, they provide a strong indirect evidence for the corrupt use of particularistic relationships. However, the direct evidence for the actual misuse of connections is harder to obtain and is only done by a few authors (Fazekas, Lukács, and Tóth 2015). The strength of combining corruption proxies from different sources such as Tendering Risk and Political Connections Indicators is exactly to provide the additional evidence needed to firmly identify corrupt exchanges as opposed to legitimate business activities of political office holders.

Future research should address the biases emanating from using one or the other measurable type of political connections by, for example collating different types of connections data (Table 5) and combining corruption proxies from the four different parts of the corrupt exchange.

TABLE 5. SUMMARY OF POLITICAL CONNECTIONS INDICATORS

Indicator name	Indicator definition
Direct personal ties	1=Kinship, friendship, or membership in associations between political office holder and bidding firm owner/manager 0=none of these
Indirect personal ties	Geographical proximity between political office holder and bidding firm owner/manager
Revolving door	1=Political officeholder(s) moving between public office and bidding firms 0=no such movement
Political party donations	1=Bidding company or individual associated with bidding firm donating to party or individual electoral campaign 0=no political donation linked to bidding firm
Lobbying	1=Lobbying activity by/linked to bidding firm targeting political office holders 0=no involvement in/link to lobbying

4.3 Supplier risk indicators

This section discusses corruption proxies capturing corruption risks of companies winning public procurement contracts (i.e. suppliers). Suppliers in a corrupt exchange have to act as vehicles of rent extraction, distribution and hiding which are indispensable for rewarding all the participants of the corrupt deal and avoiding detection. As corrupt rent extraction in public procurement differs from competitive tendering, it is hypothesized that corrupt companies are different from their peers in a number of fundamental characteristics.

Identifying corrupt companies based on publicly available data is an inherently challenging exercise. As the motives and techniques behind particularistic contract allocation can be very different in various contexts, even theoretical expectations can be ambiguous. For example, while diverting money to enrich the owners of a particular supplier leads to a very obvious increase in company profits, when corruption aims to favour a company group or a voter group, companies might be used as a distribution channel without observable effects on profitability. As there is no single attribute that could capture 'risky' companies, a more comprehensive approach is used: companies are evaluated according to multiple dimensions, all of which are validated by prior research as being a distinctive feature of firms participating in particular types of corrupt exchanges.[10] Although, we do not define one composite indicator explicitly, we do suggest individual indicators that can be calculated widely, and combined into a single corruption risk score on the company level.

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[10] To highlight the potential 'red flags' through an example company, we briefly discuss a Hungarian scheme investigated by both national and international bodies. EU-Line Ltd is a construction company, which made 6.4 billion HUF contracts (ca. 21 million EUR) as a consortium member within 3 years of its registration of which 5.5 billion HUF (ca. 18 million EUR) came from one inner district of Budapest. It was established by a 26-year-old maintenance worker without any experience in construction business. It turned out, that its location is the same, where another 5 companies are located, that could be connected to another construction contractor (Mr. Borzován), who is the beneficiary of numerous off-shore companies, and had close contractual ties to the same district council where EU-Line was operating. Both the Department of Corrupt and Economic Crimes of the Hungarian Police and OLAF[10] has ongoing investigations on.

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We discuss supplier risk indicators (SRIs) in four groups following the main data types and corruption techniques: company registry attributes, company financial information, company ownership and management data, and company governance information. For each indicator group, i) we give a comprehensive overview of the existing literature on indicator definition and validity, and ii) propose several widely applicable indicators. As the state of evidence in this field is a lot more fragmented in this area than the two previous indicator groups, most of the subsequent discussion calls for further work rather than presenting well-tested widely applicable indicators.

Company registry attributes

Company registry information captures the most essential characteristics of government suppliers such as headquarters location, incorporation date, size, or liquidation procedure. These characteristics do not signal direct involvement in corrupt exchanges, rather they suggest that the company's set-up and essential characteristics are anomalous compared to known clean businesses, potentially supporting corrupt rent extraction. The logic behind linking company characteristics to corrupt exchanges can be twofold: they either indicate the company's suspicious link to government contracting directly, or they suggest opaque operations more broadly.

Table 6 summarizes the main risk indicators suggested by previous studies, while some examples are discussed in detail here. First, location can be used to increase the cost of possible investigations, hence distant companies (especially the ones located in more corrupt areas) winning small scale contracts can point at corruption[11] (Caneppele, Calderoni, and Martocchia 2009; de Willebois et al. 2011). On the other hand, Coviello & Gagliarducci (2010) finds that in case of long term political stability (majors winning in several consecutive elections), local companies tend to win with a higher probability, while the number of bidders decreases and the costs of government contracts increases. Therefore, both high proximity and unusual distance between the procuring body and the winning firm can signal corruption. Second, multiple companies registered at the same address often hide dubious connections between the companies as discussed in Caneppele, Calderoni, and Martocchia 2009). In such cases, companies often do not have "real" activity, they only act as a vessel, while the work itself is performed by a third party. Furthermore, winning contracts with a "clean" company and executing it with another is a common feature of organized crime. Third, incorporation date can also indicate corruption, especially by combining it with additional information: companies which are established around a government change or right before winning large contracts are likely to be used as vehicles for rent extraction rather than genuine business activities, especially if they are unusually successful (Fazekas, Lukács, and Tóth 2015). Joint ventures established by long-standing companies represent an obvious false positive case, which nevertheless can be separately identified by looking at company ownership links. Furthermore, when a company is only used for winning specific government contracts and extracting rents from them, its abrupt dissolution right after contract completion should raise red flags.

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[11] Although (Caneppele, Calderoni, and Martocchia 2009) focuses on mafia infiltration, as mafia related companies are very often involved in public procurement corruption as well, the case studies are indicative.

TABLE 6: SUPPLIER RISKS –COMPANY REGISTRY ATTRIBUTES

source	indicator used	Country	year	sector	potential for international comparison
Coviello & Gagliarducci (2010)	Location of the company's head office	Italy	2000-2005	General procurement	HIGH Location of the company's head office is widely available in most of the countries.
(Caneppele, Calderoni, and Martocchia 2009)	Location of the company's head office	Italy	n.a.	General procurement	HIGH Location of the company's head office is widely available in most of the countries.
(Caneppele, Calderoni, and Martocchia 2009)	Same address for many firms/multiple head offices	Italy	n.a.	Not sector specific	HIGH Location of the company's head office is widely available in most of the countries.
(Fazekas, Lukács, and Tóth 2015)	Incorporation date	Hungary	2009-2012	Construction	HIGH Company's incorporation is widely available in most of the countries.
(ZIndex 2014)	Incorporation date	CZ	n.a.	General procurement	HIGH Company's incorporation is widely available in most of the countries.
(ZIndex 2016)	Company is under non-standard/abrupt dissolution	CZ	n.a.	General procurement	LOW Information on company dissolution is not available widely across countries.

While Table 6 gives an overall summary of prior literature on company attributes which are indicative of corruption, Table 7 provides the details of indicators that can be widely calculated based on publicly available company databases. There are three indicators related to company location: multiple companies at the same address, company location in a corrupt region and local winner company. As many companies can have a common address (e.g. in case of common ownership), and non-corrupt companies can also be located in 'corrupt regions' (corrupt regions defined by independent corruption indicator such as Tendering Risk Indicators), these indicators only serve as distant approximations of corruption risks on their own. The external validity of these indicators still needs to be tested, as they are primarily based on a few, country specific cases. Furthermore, as local companies winning a high share of municipal contracts can simply indicate the lower transaction costs due to geographical proximity, the local supplier proxy should ideally be combined with political cycles and other corruption risk indicators to reliably estimate corruption.

Company incorporation date might be associated with corrupt companies more closely, especially in combination with their winning patterns (see indicators based on company financial information). While company age in itself can be an inaccurate proxy, connecting it to the dates of contract award or political changes can serve as a useful indicator. A company winning significant government contracts within months of its incorporation, or the company incorporation and contract award coinciding with government change, can imply political favours. Lastly, while abrupt dissolution of companies is not unprecedented, its co-variation with other factors can make it very suspicious. Company mergers after performing (high corruption risk) government contracts can indicate rent sharing between the participants. Observing short-lived companies that only existed while performing the particular contract can also indicate that their existence was brought about by winning secured contracts only. While these simple indicators based on company administrative features can proxy corruption, further cross-validation with other risk factors is needed.

TABLE 7: SUPPLIER RISK INDICATORS – BASED ON COMPANY REGISTRY ATTRIBUTES

Indicator name	Indicator definition
Companies on the same tella address[12]	1=Many companies are registered at the same address 0=Only one company is registered
Company located in corrupt region[13]	1=The company is located in a corrupt region 0=The company is not located in a corrupt region
Local winner company	1=The winner company is local (e.g. same town) 0=The winner company is not local
Company's age	Number of months or years the company is in operation at the time of winning the public procurement contract (young companies are more risky)
Company incorporation around government change	Number of months between supplier incorporation and government change
Company is under non-standard dissolution	1=The company faced a non-standard dissolution after performing PP contracts 0=The company remains active

Company financial information

Company financial information represents the main annual financial data published by typically all company types, including turnover, profit rate, return on assets, or profit per employee. The links between corruption involvement and companies' financial characteristics are ambivalent: there is evidence both for high and low performing corrupt companies. This is hardly surprising, as the i) motives behind corruption, and the ii) techniques of rent allocation affect how company financial performance develops in response to government favours. On the one hand, the literature suggests that political connections or involvement in bribery increase turnover predominantly by increasing revenue from public procurement contracts. On the other hand, because of the different destinations of corrupt rents and rent re-allocation techniques, other financial indicators (e.g. profitability) show a much more diverse picture.[14]

Most studies on how corruption affects company financial performance investigate the effect of political connections. Using diverse analytical techniques, company turnover increases due to corruption (see e.g. Cheung, Rau, and Stouraitis 2011; Cingano and Pinotti 2013; Dávid-Barrett and Fazekas 2016). Overall turnover increase typically comes from public procurement contracts which often also translates into changes in the share of public procurement income in total turnover. However, depending on how corruption is organised, the connection between corruption and company efficiency and profitability varies a lot.

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[12] Alternatively, the number of companies registered under the same premises can be also used as an indicator, as it measures the same phenomenon.

[13] Tendering risk indicators can be used for establishing regional corruption levels.

[14] Besides the different motives – e.g. politicians may want to secure contracts in order to maintain employment or high salaries as a tool for getting re-elected –, rent re-allocation mechanisms also play a role here. As there are several individuals who benefit from a corrupt transaction, rent allocation is a further technical problem, often manifested in overpriced sub-contracting of the initial government contract, or signing different unrelated fake contracts.

Evidence from developed economies shows that return on assets, profitability, and productivity increase significantly through winning public contracts due to connections (Amore and Bennedsen 2013; Cingano and Pinotti 2013; C. C. Williams, Martinez-Perez, and Kedir 2016a), other studies focusing on less developed economies find conflicting evidence. While some conclude that companies involved in corruption are the less efficient and less profitable ones (Di Bono et al. 2015; Cheung, Rau, and Stouraitis 2011; Mironov and Zhuravskaya 2012), others find the exact opposite or at least a mixed picture (Blagojevic and Damijan 2012).[15]

Furthermore, another comparative indicator of corruption risk signals that a company enters a market where the average company size is significantly different (i.e. small companies winning huge contracts), as it points at the possible use of particularistic ties to gain competitive advantage over established firms (Caneppele, Calderoni, and Martocchia 2009). All the above discussed indicators are summarized in Table 8.

TABLE 8: SUPPLIER RISKS – COMPANY FINANCIAL INFORMATION

source	indicator used	Country	year	sector	potential for international comparison
(Cheung, Rau, and Stouraitis 2011)	Turnover/sales growth	Worldwide (52 countries)	1971-2007	Not sector specific	MODERATE Availability of company turnover information varies significantly from country to country.
(Dávid-Barrett and Fazekas 2016)	Turnover/sales growth	HU	2010-	General procurement	MODERATE Availability of company turnover information varies significantly from country to country.
(Cingano and Pinotti 2013)	Turnover/sales growth	Italy	1985-1997	General procurement	MODERATE Availability of company turnover information varies significantly from country to country.
(C. C. Williams, Martinez-Perez, and Kedir 2016b)	Turnover/sales growth	World-wide (132 developing countries)	2006-2014	Not sector specific	MODERATE Availability of company turnover information varies significantly from country to country.
(Goldman, Rocholl, and So 2013)	Public procurement related turnover growth	US	1990s	General procurement	MODERATE Availability of company turnover information varies significantly from country to country.
(ZIndex 2016)	High share of public procurement related income	CZ	n.a.	General procurement	MODERATE Availability of company turnover information varies significantly from country to country.
(Mironov and Zhuravskaya 2012)	Revenue per worker	RU	1999-2000	General procurement	MODERATE Availability of revenue per worker information varies significantly from country to country.
(C. C. Williams, Martinez-Perez, and Kedir 2016b)	Revenue per worker	World-wide (132 developing countries)	2006-2014	Not sector specific	MODERATE Availability of revenue per worker information varies significantly from country to country.
(Blagojevic and Damijan 2012)	Revenue per worker	27 transition countries	2002-2009	Not sector specific	MODERATE Availability of revenue per worker information varies significantly from country to country.
(Cheung, Rau, and Stouraitis 2011)	Return on assets / asset turnover	World-wide (52 countries)	1971-2007	Not sector specific	MODERATE Availability of ROA information varies significantly from country to country.
(Amore and Bennedsen 2013)	Return on assets (operating return)	Denmark	2000s	General procurement	MODERATE Availability of ROA information varies significantly from country to country.
(Cheung, Rau, and Stouraitis 2011)	Operating profit margin	World-wide (52 countries)	1971-2007	Not sector specific	MODERATE Availability of operating profit margin information varies significantly from country to country.
(Cingano and Pinotti 2013)	Profit levels	Italy	1985-1997	General procurement	MODERATE Availability of profit levels information varies significantly from country to country.
(Caneppele,	Company size	Italy	n.a.	General	MODERATE

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[15] They find that informal payments in general (although not only in the context of public procurement markets) go together with lower productivity, however, foreign and state owned firms did seem to benefit from bribing activity in new EU Member states before 2004.

Table 9 summarizes the proposed indicators that are considered to be of broader relevance based on the literature as well as our assessment considering publicly available data scope and reliability. The primary caveat of most of these indicators is that they do not only mark corrupt companies, but may also identify high efficiency, high growth, and well-managed firms. In order to minimize false positives, supplier risk indicators must be cross-validated with other corruption proxies. Nevertheless, indicators focusing on the growth of public procurement income are amply evidenced by previous research as being associated with corruption risks. Besides focusing solely on a company's income from government contracts in general, further links can be established with the source of income growth (e.g. one contracting authority) or its relationship with political regime change as suggested in Dávid-Barrett & Fazekas (2016). A related, yet exploratory, indicator is when ownership change is followed by sudden income growth. Previous studies claim, that organized crime networks infiltrate legal companies, hence enter directly into public procurement markets (Caneppele, Calderoni, and Martocchia 2009; Mazza 2016), indicating that ownership change supplemented by an increase in public procurement income can be a sign of exploited personal relations. While the ratio of the number of awarded contracts and submitted bids is not per se a financial indicator, nevertheless, it can signal unexplained market success, especially when a company has a 100% success rate (i.e. it wins every time it bids over a longer period). While simple indicators focusing on extreme income growth and performance can be highly misleading on their own, they can prove to be reliable if combined with other indicators. First, superb company performance such as extreme profit or return on assets growth can be regarded as a sign of winning overpriced contracts only if it can be connected to increased procurement income. Second, comparing company size to the value of awarded contracts can point at companies benefiting from particularistic relationships or being captured by corrupt public officials either of which only holds if the company operates in a well-established market without disruptive, but non-corrupt newcomers possessing innovative technologies[16].

TABLE 9: SUPPLIER RISK INDICATORS – BASED ON FINANCIAL DATA

Indicator name	Indicator definition
Extreme growth of public procurement income	Company's public procurement income growth/industry average public procurement income growth
Extreme growth of public procurement income share	Growth in public procurement income within total income per year (outliers are risky)
Extreme growth of public procurement income after ownership change[17]	Growth in company's public procurement income after ownership change
Change in public procurement income	Growth in the company's public procurement income after a political regime change (outliers are risky)

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[16] In practice, some simpler indicators are also used, such as missing financial records, etc. (ZIndex 2016).

[17] This indicator is only a theoretical consequence of previous studies. However, in certain cases, corrupt parties need to buy-in into new industries, in order to win tailor-made contracts with the newly acquired branch.

after political change	
Company winning probability	The company's number of awarded contracts divided by the number of its submitted bids.
Extreme growth in return on assets	Growth in return on assets (outliers are risky)
Extreme profit growth	Profit growth (outliers are risky)
Extreme reliance on public procurement income	Share of public procurement-income within total company turnover in a period (outliers are risky)
Extreme concentration of public procurement income	Share of largest buyer within the company's public procurement income (outliers are risky)
Large contract size compared to company size	Public procurement contract size is disproportionately high compared to company size (i.e. average yearly turnover)

Ownership and management

Ownership and management databases describe the publicly registered direct owners of companies and those officials which are required to be publicly registered such as members of the board of directors. Missing or hidden company ownership and management data can point at corrupt dealings in several ways (Table 10). It is the beneficial owner who ultimately wants to benefit from the company's corruptly earned profit from government contracts, therefore hiding the identity of beneficial owners is a frequent characteristic of corrupt procurement contracting (Fazekas and Kocsis 2015). Depending on the nature of the corrupt transaction, the 'true' ownership can be either hidden directly (i.e. the information is not available) or indirectly by using a strawman. As de Willebois et al. (2011) shows, grand corruption often involves hidden owners in at least two ways: either using opaque jurisdictions to register a company, i.e. tax havens such as Panama; or simply failing to correctly register owners or ownership changes.[18] Another way of hiding ownership is using complex company ownership structures – even without including foreign ownership. Riccardi & Savona (2013) shows that "Chinese-box" schemes[19] in company ownership are often used in mafia infiltrated companies. In Italy, an entire company group was controlled by one person, which won public procurement contracts in a fraudulent manner. Furthermore, information on managers and legal representatives can also signal corruption as they are indispensable for corrupt exchanges: for example, they can also act as the owner's strawman so that he/she remains unknown.

Besides missing information, publicly available ownership information can also point at corruption risks. As it was already discussed with regards to financial indicators, ownership change and public procurement income growth can indicate undue benefit from personal relations (Caneppele, Calderoni, and Martocchia 2009; Mazza 2016). A related risk factor is

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[18] Exploring ownership structure is also a canonized feature in due diligence processes (Lex Mundi, 2014; World Economic Forum, 2013).

[19] A Chinese-box scheme is when the beneficial owner (the natural person behind companies) controls several companies through intermediary firms (indirect shares). Controlling companies often secured through a strawman.

when one company's owner is involved in proven or investigated economic crime perpetrated by another legal entity (Caneppele, Calderoni, and Martocchia 2009; ZIndex 2016).

A further indication of corrupt companies according to organised crime literature is the socio-economic profile of owners and managers (Caneppele, Calderoni, and Martocchia 2009; Riccardi, Soriani, and Giampietri 2016). Companies in the same industry tend to have similar age, gender and educational profiles, hence a company's suspicious deviation from industry average socio-economic characteristics can indicate corrupt activities.[20] Similarly, CEOs governing several companies can also indicate corruption risks (Caneppele, Calderoni, and Martocchia 2009).

TABLE 10: SUPPLIER RISKS – OWNERSHIP AND MANAGEMENT

source	indicator used	Country	year	sector	potential for international comparison
(de Willebois et al. 2011)	Beneficial owners unknown/untraceable (company incorporated in a tax haven)	World wide	n.a.	Not sector specific	MODERATE Availability of ownership information varies significantly from country to country. However, companies incorporated in tax havens can be identified easily.
(Lex Mundi 2014)	Beneficial owners unknown/untraceable (company incorporated in a tax haven)	n.a.	n.a.	Not sector specific	MODERATE Availability of ownership information varies significantly from country to country. However, companies incorporated in tax havens can be identified easily.
(Riccardi and Savona 2013)	Complex ownership structures	Italy	2007	Construction	MODERATE Availability of ownership information varies significantly from country to country.
(Caneppele, Calderoni, and Martocchia 2009)	Owners affiliated with companies already closed/under investigation	Italy	n.a.	General procurement	LOW Information on closed/investigated companies cannot be easily connected to active companies' ownership.
(ZIndex 2016)	Owners affiliated with companies already closed/under investigation	n.a.	n.a.	General procurement	LOW Information on closed/investigated companies cannot be easily connected to active companies' ownership.
(Caneppele, Calderoni, and Martocchia 2009)	Age/education/gender profile of the company's owners/legal representatives	Italy	n.a.	General procurement	MODERATE Availability of managerial information varies significantly from country to country.
(Caneppele, Calderoni, and Martocchia 2009)	Representation of several companies	Italy	n.a.	General procurement	MODERATE Availability of managerial information varies significantly from country to country.

Based on previous evidence on ownership and management-related corruption risks, Table 11 succinctly summarizes the proposed indicators that can be calculated widely across countries. First, hiding beneficiary ownership can be indicated in three ways: i) registration in tax havens or countries with high financial secrecy, ii) lack of ownership disclosure, iii) hiding ownership through 'Chinese-box' ownership schemes. Although each of these indicators can signal legitimate purposes as well – some countries may have lax regulations on ownership registration or companies may fail to comply with administrative regulations – hiding

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[20] See the previously cited example from Hungary, where a construction company winning million EUR contracts was led by a 26-year-old maintenance worker.

ownership is directly relevant for the beneficiaries of corrupt exchanges. Second, ownership change can be indicative of corruption when supplemented with extreme growth in public procurement income.[21] Third, measurable characteristics of company management can also be associated with corrupt company behaviour. Both outlier management profile within a given industry in terms of educational level, age or gender, and managers/directors representing several companies at the same time[22] can be regarded as an indication of corruption risks.

TABLE 11: SUPPLIER RISK – OWNERSHIP AND MANAGEMENT

Indicator name	Indicator definition
Company is located in a tax haven (or a financially secretive country)	1= The company or its parent company is located in a tax haven or high FSI[23] country 0=The company is not located in a tax haven or high FSI country
Company fails to report owners	1=The company does not report ownership in official records 0=The company does report ownership in official records
Company has a complex ownership structure	1=The company has a complex ownership structure 0=The company does not have a complex ownership structure
Change in ownership before winning PP contracts	1=There is a change in ownership before winning PP contracts 0=No ownership change before winning PP contracts
Manager represents several companies	Number of companies a manager represents compared to the industry average (outliers are risky)
Odd age/gender/educational profile of ownership or management	1=The age, gender and education profile of company ownership and management is an outlier compared to industry average 0=No unusual age, gender and educational characteristics of the company's ownership and management structure

Company Governance

By corporate governance we understand the way responsibility and discretion is allocated within a corporation, which is directly related to principal-agent problems. The way internal responsibilities are aligned and management performance is monitored directly affects the cost of corruption both at individual and organizational levels. The main focus of the corporate governance literature is on its connection with company performance in general such as financial performance or company value (Silva and Leal 2005). Unfortunately, only very few studies investigate corporate governance and corruption, hence there is only scattered evidence on how different governance set-ups signal corruption risks. Although there is some theoretical discussion on how monitoring corruption should be structured within organizations (Banfield 1985), empirical inquiries are limited, and most of the research is based on cross-country surveys instead of company-level analysis.

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[21] Although, ownership change can lead to 'natural' shifts in public procurement income as different ownership strategies exists, hence it must be contrasted with other indicators as well.

[22] As in case of every corrupt transaction, a trusted relationship is needed between the 'principal' (owner) and the 'agent' (manager), the same manager/straw man have to be trusted with the execution in more companies.

[23] FSI refers to the 'financial secrecy index', an indicator developed by the Tax Justice Network. The main feature of this index is that by combining both qualitative and quantitative data, it creates a measure of financial secrecy for each country (e.g. it measures whether beneficial ownership has to be recorded or disclosed when establishing a company).

A relatively intuitive and empirically verified result is that external supervision or monitoring can decrease corruption risks. Wu (2005) finds, that the efficacy of corporate boards in representing outside shareholders (measure from the Global Competitiveness Report) is negatively correlated with corruption (TI's corruption perceptions index), while Wu (2008) shows that bribing propensity is higher in companies governed by individual owners or families vs. the ones governed by boards. In a similar vein, Jeong and Weiner (2012) finds that privately owned firms pay significantly more bribes abroad than publicly owned ones in the petroleum industry. Besides the ownership and management setup, financial transparency can also be indicative of corruption risks: Wu (2005) finds the quality of accounting is negatively associated with corruption (TI's corruption perceptions index). These findings are summarized in Table 12.

TABLE 12: SUPPLIER RISKS – COMPANY GOVERNANCE

source	indicator used	Country	year	sector	potential for international comparison
(X. Wu 2008)	Private or family vs. board management	12 Asian countries	Early 2000s	Not sector specific	MODERATE Availability of managerial and ownership information varies significantly from country to country.
(Jeong and Weiner 2012)	Private ownership	51 countries	2000-2002	Not sector specific	MODERATE Availability of managerial and ownership information varies significantly from country to country.
(X. Wu 2005)	Existence of corporate boards	72 countries World Wide	n.a.	Not sector specific	MODERATE Availability of managerial information varies significantly from country to country.
(X. Wu 2005)	Level of accounting standards	72 countries World Wide	n.a.	Not sector specific	LOW Information on companies' accounting standards are not widely available.

Although, company-level measures of corporate governance could be used for the evaluation of corruption risks, there is no publicly available database. Therefore, we do not propose any corporate governance related risk indicator, it remains a theoretical possibility for now.

4.4 Contracting body risk indicators

For the purpose of our analysis, we define contracting body risk indicators as any quantitative measure that has the potential of capturing the risk of particularistic allocation of public funds by contracting bodies. We define contracting bodies in the same generic way the EU procurement directives define a contracting authority as either a public authority with legal personality or any other body governed by public law which a) is established with the purpose of meeting the general interest; b) has a legal personality and c) is financed fully or partially by the state (OECD 2011).

Although this universe will vary by country and cover different landscapes of organizations, it will generally match the organizational level by which each public agency corresponds to one contracting body[24]. For operational reasons, however, the indicators assessed will correspond to the first type of contracting bodies: organizations belonging to the corpus of

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[24] There are clear exceptions to this principle, as for example, it is the case in most countries that ministerial sub-units do not constitute contracting authorities, or municipalities constitute single contracting authorities although they are made up of multiple organizational units.

the public administration. This leaves out public bodies governed by public law such as non-governmental organizations or publicly funded companies, although indicators are equally applicable to these organisations if data can be obtained[25].

We posit in this section that the set of organizational features enjoyed by the contracting body represents a key determinant of the possibilities of public funds misallocation in procurement. It is understood that the formal and informal rules guiding organizational behaviour constitute a particular opportunity matrix for corruption, encouraging certain practices and discouraging others. This approach does not rule out the two other levels playing a strong role in determining corruption risks: the individual level covering motivations and preferences, and the macro level covering the wider institutional setup in which single organizations are embedded. While the latter is better covered by the systemic corruption risk indicators of the political connections indicators (PCIs), the former is excluded from our analysis for the sake of parsimony.

In the rest of this section we shall proceed as follows. We first review current measures that aim at capturing corruption risks at the organizational level, and assess them against our benchmark requirements for indicators. And secondly, we propose a series of guidelines on new indicators based on the current availability of data in the field of public procurement and other similar sources.

Existing agency-level indicators

The field of comparative public administration continues to face enormous challenges when it comes to delivering high-quality empirical measures to test hypotheses. As Fukuyama stated rather recently, finding adequate administrative measures that are deep in time and comparable across countries has been a long-standing and rather unsuccessful challenge (2013). Numerous institutions and scholars have advanced relevant indicators with cross-country comparative potential. Yet, these indicators suffer from a number of methodological problems, of which the most salient for the purpose of our study is that they treat national bureaucracies as monolithic and homogeneous entities, which for many years now has been extensively proven not to be the case (e. g. Allison 1969).

We therefore review a series of measures and indicators that aim at capturing relevant agency-level characteristics that might be informative of public procurement corruption risks in the framework of our systemic approach to the subject. Arguably, some of the below indicators are less directly related to corruption and sometimes rely on perceptions data both of which set this indicator group aside in comparison to the preceding indicator groups. This is because the literature is much less advanced in this field.

Based on a general inductive search of indicators, we use the same dimensions of indicator quality as set out in the conceptual section (section 2) when selecting the most promising corruption proxies: a) objective; b) de facto; c) micro-level (i.e. characterising individual organisations within countries); d) internationally comparable; e) comprehensive regarding the type of agencies covered at the national level; f) capacity to capture time variations through consistent historical data. For further insights on indicator construction in the area of integrity, see Trepnell (2015) and UNDP (2007).

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[25] See European Commission (2016) for an overview of the organizational governance of procurement in EU member states.

Also, we find that our inductive search retains indicators whose final objective is to measure five different organizational features relating to corruption risks: organizational capacity, influence (political and corporate), integrity, transparency and accountability. We summarize the reviewed indicators and their features in Table 13.

TABLE 13. AGENCY-LEVEL INDICATORS INFORMING CORRUPTION RISKS

Source	Indicator used	Feature	Objective	De facto	Comprehensive	Countries	Years	Potential for international comparison
Williams (2015)	Transparency index	Transparency	Yes	Yes	No	World	1980-2010	Yes
Bertelsmann Foundation	SGI	Transparency	Objective & subjective	Yes	No, but multiple	OECD - EU	2014-15	Yes
Global Integrity	GIR	Transparency, accountability	No	de jure & de facto	No	Multiple, worldwide	2004-11	Yes
European Commission	IFID	Influence (political)	No	Yes	No	EU	2006-14	Yes
Tadat.org	TADAT	Transparency, accountability	Yes	Yes	No	Multiple, developing	2013-2015	Yes
(Lamboo, Dooren, and Heywood 2015)	Public integrity systems	Transparency, integrity	No	Yes	Yes	Some EU	2004-2015	Limited
Alavateli	FOIA portals	Transparency, capacity	Yes	Yes	Yes	Multiple, worldwide	Various	Yes
European Commission (2016)	No consolidated indicator	Capacities	Yes	de jure & de facto	Yes	Some EU	2015	Yes

Grounded in developmental economics, the work of Williams, (2015) has produced an overall index of transparency, combining information and accountability transparency. Among the sub-components of information transparency, he includes an index of Central Bank procedural transparency, defined as "*the transparency surrounding the way monetary policy decisions are made, including whether the central bank publishes comprehensive accounts of their deliberations, and whether the voting records of the board or committee are disclosed to the public*" (p. 7). This index is composed of a) the average of five variables computing the quarterly release of data on: money supply, inflation, GDP, unemployment rate and capacity utilization; b) a variable capturing whether the central bank discloses the macroeconomic models it uses for policy analysis; c) a variable capturing whether the central bank regularly publishes its own macroeconomic forecasts (p. 8)[26].

With regards to a different agency type, the latest survey of the Public Expenditure Financial Accountability programme PEFA (2016) includes an indicator on the independence of the Supreme Audit Institution (SAI). The scoring of PEFA is given by a four-point ordinal scale, ranging from letters A (best institutions) to D (worst institutions). When evaluating the SAI's independence scoring "A" corresponds to countries where the SAI operates independently from the executive in the following areas: a) appointment and removal of the SAI's head, b) auditing, c) the publication of reports, and d) the approval and execution of the budget. At the same time, the SAI has timely and unrestricted access to relevant records and

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[26] For more details, see: https://andrewwilliamsecon.files.wordpress.com/2014/11/jcec-article-in-press-nov-2014.pdf

documents. Score "B" is given if the SAI is independent from the executive on dimensions a), b) and d), and it has unrestricted and timely access to information for most of its audited entities. Score "C" corresponds to independence regarding dimensions a) and d), and unrestricted and timely access to the majority of the requested information. Any performance below C is rated with the "D" letter[27]. Independence of public bodies from political influence is considered to be a key hallmark of anticorruption as for example when permanent bureaucrats' and elected politicians' career pathways are separated they are more likely to mutually monitor each other reducing the likelihood of corrupt transactions (Charron et al. 2016). When enumerating further indicators of organisational independence we rely on very similar arguments.

In a similar endeavour, the Sustainable Governance Indicators (SGI) measure the quality of accountability of the Auditor General through an expert survey, in a scale between 1 to 10, where: 9-10 means the audit institution is exclusively accountable to the Parliament; 6-8 means that the SAI is only primarily accountable to the Parliament; 3-5 means the office is not accountable to the Parliament but has to report to it regularly and 1-2 means that the office is governed by the executive[28].

Regarding the accountability and transparency of tax authorities, the Tax Administration Diagnostic Assessment Tool - TADAT[29] - captures a number of dimensions relevant for corruption risk assessment: internal audit mechanisms; staff integrity; external oversight; the nature of the investigation process for any wrongdoing or maladministration; public perceptions of integrity; publication of activities, results and plans; public accessibility to agency's performance reports; public accessibility to agency's strategic planning.

More comprehensively, the Global Integrity Report's survey captures corruption-related aspects of various unique agency types in the format of expert assessments, with partially comparable questions across agency types. It has the added value of measuring both *de jure* and *de facto* characteristics. It addresses the list of organizations and characteristics as the following[30]:

- Ombudsman: protection from political interference, both in law and practice; existence of full-time professional staff; professionalism regarding agency appointments; regularity of funding; availability of reports for the citizenry both in law and in practice; availability of reports in a timely and non-expensive manner.

- Supreme Audit Institution: Same dimensions as Ombudsman.

- Tax collection agency and customs: existence of full-time professional staff; regular funding.

- Agency for the oversight of state-owned enterprises: protection from political interference in law; existence of full-time professional staff; regularity of funding; availability of company records for the citizenry both in law and in practice; availability of reports in a timely and non-expensive manner.

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[27] For more details, see: http://www.pefa.org/sites/pefa.org/files/PEFA%202016%20FINAL%2016-01-29.pdf

[28] For more details, see: http://www.sgi-network.org/docs/2015/basics/SGI2015_Overview.pdf

[29] http://www.tadat.org/

[30] For more details and data see: https://www.globalintegrity.org/wp-content/uploads/2013/08/GIR11_data.xls

- Anti-corruption agencies: protection from political interference in law and in practice; professionalism regarding agency appointments; existence of full-time professional staff; regularity of funding; availability of reports in a timely manner for citizens.

The Independent Fiscal Institutions Database (IFID) is an initiative of the European Commission aiming to produce systematic data on the governance and autonomy of independent fiscal institutions in Member States. It considers a small number of independent fiscal institutions per country that are functionally independent from fiscal authorities, and are defined as "*nonpartisan public bodies, other than the central bank, government or parliament that prepare macroeconomic forecasts for the budget, monitor fiscal performance and/or advise the government on fiscal policy* **matters."** Courts of Auditors are included if their activities go beyond the accounting control[31]. In the latest survey, a series of mostly *de jure* autonomy dimensions were analysed, covering mandates and functions, composition of boards, legal accountability to the executive and parliament, media visibility and influence on public debates about fiscal policy. Some of the key questions informative of corruption risks are: board members' types of nomination and appointment procedures; renewability of mandates; conflict of interest/incompatibility between holding top-management positions at the institutions and holding political posts.

The work of (Lamboo, Dooren, and Heywood 2015) showcases a number of country studies where particular frameworks were developed in order to monitor staff integrity in public organizations. It includes examples from Belgium, Croatia, Estonia, Hungary, Netherlands and Poland, where these public integrity systems took different formats. In all cases, however, the assessment was done through surveys of public officials measuring dimensions such as integrity awareness, attitude, ethical climate or misconduct. Although surveys are based on perceptions, the limitations of subjective information are countered by the direct access that officials have to organizational dynamics. Moreover, the study reports how these surveys are in many cases a regular exercise (therefore allowing time-comparisons), and how they may be complemented with other external and objective sources of information on corruption/integrity.

The next database did not produce consolidated indicators, but it represents a source of information with great potential for informing levels of agency transparency and accountability in a comprehensive manner and across big pools of organizations. The biggest initiative in this respect corresponds to Alavateli, a product developed by MySociety, a UK-based non-profit organization that works on IT tools for citizen accountability. Alavateli is its specific tool for channelling and publishing Freedom of Information Requests[32]. It currently works for 25 countries around the globe, and in most cases all the information has a similar structure: a list of public authorities in the country (at all jurisdictional levels), the number of total requests by authority, as well as the number of successful, unsuccessful and unresolved requests.

Finally, another source that does not provide corruption indicators directly, but is considered to be relevant to the study of corruption more broadly is a report released by the European

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[31] For more see:
http://ec.europa.eu/economy_finance/db_indicators/fiscal_governance/independent_institutions/index_en.htm

[32] http://alaveteli.org/deployments/

Commission (2016) on organizational capacities for public procurement in EU countries[33]. While most tools assessed capture administrative capacity, some of them coincide with other similar frameworks capturing corruption risks, such as the existence of IT systems in place or risk management. According to this report, administrative capacity for procurement *"relates to available resources in central bodies responsible for drafting and implementing the procurement policies as well as in contracting authorities at all levels which carry out tender processes."* (p. 30). This concept is captured through five qualitative and quantitative dimensions (the most corruption-relevant aspects highlighted in italics):

- The number of procurement staff at key procurement organizations (legislative, central purchasing authority, procurement oversight, etc.) relative to the quantity and value of procurement managed;

- The number of contracting authorities relative to total procurement in the country more fragmented less specialization;

- The types of qualification required from procurement expert officials.

- The number and nature of trainings.

- *The existence of different tools, such as IT systems, risk management tools, templates, guidance materials or standardized tender documentation.*

An agenda for the future

Drawing inspiration from many of the existing indicators, and considering further possibilities offered by micro-level procurement data, as well as other machine-collectable sources of information, we propose a series of guidelines on complementary indicators that can inform corruption risks at the organizational level.

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[33] For a comprehensive overview on administrative capabilities beyond procurement see Lodge & Wegrich (2014).

TABLE 14. SUGGESTIONS FOR FUTURE AGENCY-LEVEL CORRUPTION-RISK INDICATORS

Auditing information

Internal auditing

- Frequency of internal auditing;
- De jure and de facto governance process of internal auditing;

External auditing

- Open reports by the Supreme Audit Institution;
- Open reports by international agencies;

Prosecution procedures

- Metrics on charges related to all different corruption-related offences;
- Media tracking of corruption offences at the agency level;

Budget information and procurement announcements

- Details of agency-level expenditure: ratios of spending on a) personnel, b) current expenditure, c) financial services, d) transfers and e) investments to total expenditure.
- Ratio of procurable expenditure reported in budget to total procured amounts reported in announcements;
- Ratio of emergency or contingency funds spend to total expenditure;
- Extension of tender publicity aggregated at the agency level;
- Usage of eProcurement;
- Number of appeals related to procurement;

Asset declarations

- Ratio of headcount declarations to total of legally accountable population;
- Structural breaks over time in asset declarations of agency officials;

Other

- Openness of job recruitment processes;
- Responsiveness to citizen information requests.

4.5 Combining indicators from the four groups

The preceding sections discussed the four major corruption risk indicator groups and many individual indicators within them. As we highlighted on several occasions already, many if not all indicators suffer from overestimating corruption risks as there are many alternative, non-corrupt circumstances where the indicators signal risk (i.e. false positives). Take for example, extremely high turnover growth from public procurement, while there are certainly cases where this is due to government favouritism, it is highly likely that many innovative companies entering the procurement market would produce very similar patterns. In such cases, eliminating false positives is only possible through triangulation. Using trusted corruption indicators from outside procurement is one way of doing this. The alternative, which we very much advocate, is to combine multiple corruption proxies either from the same indicator group or from different groups in order to arrive at a more robust corruption proxy. Corruption proxies can be collated and used for triangulation only if they capture the

same type of corrupt exchange, if they mark substitutive or unrelated corrupt processes triangulation will only confuse signals. One example of successfully combining corruption proxies from different indicator groups is when high turnover growth is cross-validated by Tendering Risk Indicators in the contracts won by the government suppliers which is a straightforward way of separating legitimate high-growth firms from favoured companies (Dávid-Barrett and Fazekas 2016).

While combining multiple corruption risk indicators form within one group or from different groups can underpin validity and help eliminating false positives, due to the assumed but highly likely underestimation of actual corruption by even the best proxies, combining corruption risk indicators in an additive fashion can also bring about benefits. For example, it is quite possible that some types of political connections cannot be tracked as they are based on publicly less visible relationships such as membership in a private society. In such cases, relying on tendering risks for example is preferable to simply concluding that corruption risks are minimal.

Clearly, there is a tension between triangulating indicators or using them in an additive fashion which can only be resolved on a case-by-case basis carefully considering research and policy goals (e.g. how problematic false positives are compared to false negatives).

5. Discussion

Our extensive review has screened a rich landscape of corruption proxies in public procurement revealing many alternatives and analytic nuances. In this endeavour, we have paid particular attention to combining indicators from different disciplines and systematically assessing the indicators pertaining to all four major components of corrupt exchanges in public procurement: i) the awarded contract; ii) the particularistic tie; iii) the awarding body; and iv) the winning bidder. A few key lessons have emerged from our work which can guide future work.

First, there is a surprising wealth of objective corruption risk indicators in public procurement and related fields using a wide range of data sources which are nevertheless widely available for academic and policy research. Most of the key databases and indicators covered by the review can be accessed and downloaded at digiwhist.eu/resources/data.

Second, while there are many indicators used in narrowly defined contexts and even occasionally explicitly validity tested, a lot more needs to be done the precisely define the scope of applicability of each indicator and their validity and reliability. Indicator assessments need to provide proof of both internal and external validity, as well as construct validity in general. Methodologies need to account not only for possible biases, but also for the quality and consistency of aggregation methods, robustness and stability, complementarity between indicators and external indicators coming from different databases, acknowledge trade-offs, and report on indicators' limitations. As high-level institutionalised corruption in public procurement represents a diverse and dynamically changing phenomena throughout Europe and globally, a necessary part of establishing indicator validity is to clearly state the kind of corrupt exchange proxied and the borders of reliable application in terms of country, market, or regulatory framework to name a few critical factors. In general, indicator validity should be established by cross-checking different corruption proxies designed to signal the same form of corrupt exchanges as well as bringing in trusted corruption indicators from outside the public procurement domain.

Third, not all of the indicators assessed were originally meant to measure corruption. Before using them, it is therefore important to be endowed with a strong conceptual understanding of the channels through which some indicators feed into the corruptions risks literature. In particular, it is relevant to separate those indicator dimensions which can really speak to corruption risks from those which cannot.

Fourth, the literature we have assessed is generally not interconnected. There is therefore a need to harmonize the theories under which indicators are meant to be used, as well as map clearly which are the unresolved or contested theoretical aspects where complementary indicators are needed. This greater integration of disparate academic strands is also needed because it is very difficult for any single indicator or approach to fulfil all desired indicator properties on its own. In this sense, it is key to advance discussions about avoiding the duplication of efforts by different scholars and organizations, and rather discuss complementarity and walk towards more consolidated consensus regarding measurement initiatives.

Finally, scholars and practitioners launching indicators which measure sensitive governance issues like corruption need to be more self-reflective about sample selection biases or any obstacle that impedes a certain amount of data being truly representative of the full universe of cases. Moreover, researchers using databases on corruption risks need to acknowledge

(or at least be aware) that the detection of corruption risks is largely dependent on the amount and quality of data published. In this respect technological preconditions underpinning or inhibiting more and better data release need to be directly considered.

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