From corruption to state capture: A new analytical framework with empirical applications from Hungary

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ABSTRACT

State capture and corruption are widespread phenomena across the globe, but their empirical study still lacks sufficient analytical tools. This paper develops a new conceptual and analytical framework for gauging state capture based on micro-level contractual networks in public procurement. To this end, it establishes a novel measure of corruption risk in government contracting focusing on the behaviour of individual organisations. Then, it identifies clusters of high corruption risk organisations in the full contractual network of procuring authorities and their suppliers using formal social network analysis. Densely connected clusters of high corruption risk organisations are denoted as the domain of state capture. It demonstrates the power of the new analytical framework by exploring how the radical centralisation of the governing elite following the 2010 elections in Hungary impacted on centralisation of state capture. Findings indicate the feasibility and usefulness of such micro-level approach to corruption and state capture. Better understanding the network structure of corruption and state capture opens new avenues for research and policy on anti-corruption, budget deficit, market competition, and quality of democracy. Supporting further empirical studies of corruption, the data is made available at digiwhist.eu/resources/data.

1. INTRODUCTION

There has been intense scholarly interest in state capture across the globe, although virtually every study has had to rely either on qualitative data lacking sufficient breadth, or on survey data lacking sufficient reliability. These methodological weaknesses have spawned a rich theoretical literature but relatively meagre empirical material against which to evaluate it. With the recent availability of reliable micro-level data on corruption and favouritism in public procurement (Auriol, Flochel, and Straub 2011; Bandiera, Prat, and Valletti 2009; Klasnja 2016), scholars can begin to rigorously test theories of state capture and investigate underlying actor networks and corrupt transactions.

It is our starting point that state capture is not just widespread corruption. Rather, its essence lies in a distinct network structure in which corrupt actors cluster around parts of the state allowing them to act collectively in pursuance of their private goals to the detriment of the public good. By analysing the distribution of corrupt transactions and clustering of corrupt actors across organisations, it is possible to estimate the degree of state capture. For example, it becomes possible to distinguish between localised and systemic forms of state capture where in the first case only some public and private organisations enter into a capture relationship with their 'islands' remaining relatively autonomous, while in the second case, captured organisations are linked to each other and controlled by a country-wide elite.

In order to bridge the gap between state capture theory and empirics, this paper develops a new conceptual and analytical framework for gauging state capture based on micro-level contractual networks in public procurement. The goal of this analytical framework is to determine precisely whether state capture took place in particular parts of the state; and if so, to help uncover its degree and structure.

Identifying state capture in organisational networks rests on a novel measure of corruption risk in government contracting (Corruption Risk Index). This measure captures the likelihood

of corruption occurring in a given tender by screening a wide range of micro-level 'red flags' such as a short deadline for submitting bids.

Establishing the structure and degree of state capture opens up many ways for analysing its causes and effects. In order to demonstrate the usefulness of this novel approach, the association between the organisational structure of the governing elite and the structure of state capture are explored using the change of government of Hungary in 2009-2012, albeit no causal claim is made due to the multitude of intervening factors. This is a highly relevant question on its own, as, to take one example, many anti-corruption efforts fail because they misdiagnose corruption as a principal-agent problem and miss the elite-driven character of state capture (Mills 1970; Persson, Rothstein, and Teorell 2013).

Pursuing these ends extends our current knowledge in at least two ways: first and most importantly, it gives a well-documented and widely deployable toolkit for scholars to measure state capture exploiting the micro-level structure of corruption. This, hopefully, will generate further scholarly interest in the empirical study of state capture. Second, it also provides a brief empirical test for the theories of state capture, in particular on how elite centralisation impacts on state capture structure, using the example of Hungary in 2009-2012. This is a crucial question as it has wide-ranging ramifications for many economic, social, and political factors.

Findings highlight the conceptual and empirical usefulness of the proposed approach to state capture. The proposed framework allows us to establish the risk of corruption, i.e. the likelihood of corruption occurring, in government contracting at the transaction level, while also providing clear guidance on how to use such micro-level data and indicators to precisely identify the location, degree, and structure of state capture. The method claims general applicability to countries with regulated and transparent public procurement markets including OECD countries and most middle-income countries (OECD 2015). Applying the

framework to Hungary in 2009-2012 demonstrates the methodology's research merits. It reveals that the Hungarian state was partially captured in 2009-2012, with high corruption-risk organisations becoming more central as a more centralised governing party takes power in 2011-2012 which coincides with qualitative accounts of the events. Understanding how elites organise state capture in middle-income countries has wide-ranging ramifications for anti-corruption interventions, management of budget deficits, market competition, and quality of democracy.

Even though the main focus of this analysis is public procurement corruption, findings also provide an indication of corruption in a more general sense as public procurement represents one of the principal vehicles for rent extraction across the globe. This is reflected, for example, in corruption surveys where public procurement is systematically named as the most corrupt area of government activities (OECD 2007, 9). This is not surprising given the high degree of discretion inherent in public procurement decisions and the large portion of public spending involved: between 20% and 50% of OECD countries' public budgets (OECD 2011 table 40.2). While robust evidence is lacking, corrupt rents earned through particularistic allocation of public procurement contracts are often directly linked to political party finances and democratic party competition (OECD 2014; Transparency International 2012).

The paper is structured as follows: It first sets out the conceptual framework. Second, it develops the novel measure of corruption risks in public procurement transactions focusing on binary contractual relationships between organisations. Third, it identifies organisational clusters based on their corruption level and network connections. Fourth, it systematically explores how the change in the internal composition of the governing elite (i.e. becoming more centralised) impacts the network structure of corruption in public procurement.

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

While there are many competing definitions of corruption (Johnston 1996), we adopt a broad approach which is adept at capturing high-level political corruption in situations where even some regulations could be enacted to serve rent extraction. Thus, in the context of public procurement, institutionalised grand corruption denotes the allocation and performance of public procurement contracts by bending prior explicit rules and principles of good public procurement such as public procurement laws in order to benefit a closed network while denying access to all others (for a related discussion see Kaufmann and Vicente 2011; Mungiu-Pippidi 2006; OECD 2007). This definition of corruption beyond simple bribery in public administration is well fitted to the context of public procurement where political discretion is broad and political and technocratic actors necessarily co-determine decision. Prior explicit rules and principles provide the benchmark for an impartial and universalistic allocation of public resources as opposed to partiality and particularism along friendship or kinship lines (Rothstein and Teorell 2008). In addition, prior explicit rules and principles mandate open access and fair competition for public procurement contracts and must be violated by corrupt groups if they are to generate corrupt rents and allocate them to members of their network (North, Wallis, and Weingast 2009). Such a definition of corruption is directly measured by the Corruption Risk Index (CRI) developed by earlier scholarship (Fazekas, Tóth, and King 2016).

Similar to corruption, there are many definitions of state capture, many of which focus on law making instead of public spending (Hellman et al. 2000; Slinko, Yakovlev, and Zhuravskaya 2005). A range of scholars share the understanding that state capture is a group phenomenon whereby some members of the business and/or political elite appropriates some parts or functions of the state and uses its resources to the benefit of the group while harming the public good (Grzymala-Busse 2008). This understanding of state capture does not imply whether it is business capturing the state, or the other way around, or both at the same time.

In the context of public procurement, state capture most likely involves targeting public organisations which manage the distribution and performance of contracts as these are the primary sources of rents to be extracted. When a public organisation is captured by private interests it loses its autonomy to act in furtherance of public goals which manifests in its inability to contract competitively achieving low price and high quality.

Hence, it is possible to link institutionalised grand corruption to state capture in the domain of public procurement by focusing attention on the distribution and clustering of corruption and network relations of key actors underlying collective action (Uribe 2014). On the one hand, corruption *without* state capture in public procurement is understood as institutionalised grand corruption distributed across the organisational network randomly. Corruption randomly arising implies atomised and isolated breakdowns of institutional integrity without any elite group seizing control of the state. On the other hand, state capture in public procurement is defined as institutionalised grand corruption clustered on certain public organisations which cease to serve public goals, instead are used for the captor group's own objectives. This implies that the simple quantitative characteristic - amount of corruption - does not automatically translate into state capture; rather its particular distribution is what matters. Hence, varying distributional characteristics of corruption can lead to a qualitatively different state operational logic even given the same quantity of corruption. Clusters of high-corruption transactions can arise both at the level of an individual organisation, implying that it is only that particular organisation which is captured (local capture), while it can also arise at the level of multiple organisations implying that there is a larger part of the public sector captured (global capture). Theoretically, the extent of state capture can range from a single captured organisation to the capture of every single organisation.

In order to convincingly link institutionalised grand corruption to state capture by analysing organisational networks, it is imperative to first establish a thorough understanding of what

the networks truly represent. The network of organisations consists of public organisations (issuers of tenders) and private firms (winners of tenders) where each tie represents a contractual relationship between the two. Institutionalised grand corruption as measured by CRI is a characteristic of the contract linking public organisations to private firms. In this sense, a high corruption-risk contract represents a corrupt bond between the decision makers in public and private organisations, creating a relationship based on trust, shared experience, and jointly extracted rent (della Porta and Vannucci 1999). The clustering of high corruption-risk contracts among organisations signals that the involved public and private actors have formed a group based on regular interactions which can act collectively to seize control of government contracting in pursuance of their private-regarding goals. State capture is unlikely to arise without such clustering of transactions as corrupt relationships are costly to set up and the threat of detection makes group membership turnover highly risky (Lambsdorff 2002). Hence, the degree and strength of such a clustering measure the extent of state capture ranging from partially appropriated state to a near complete fusion of private interests and state functions (Wedel 2003).

The different distributions of corruption and state capture are depicted in Figure 1 in a simplified form in order to shed more light on our proposed link between corruption and state capture. Here, I_1-I_4 represent 4 different issuers (public organisations), S_1-S_4 represent 4 different suppliers (private organisations), the dashed arrows between them denote low corruption-risk contracts, and the solid arrows indicate high corruption risk contracts. C_1 and C_2 are two clusters of contracting organisations. In the top left panel (i), a corruption-free state is depicted, consisting of two contractual clusters, each of which is largely free of corruption and hence also of state capture . In the top right panel (ii), corruption displays a random pattern without being organised into clusters of corrupt organisations. As each cluster of contracting organisations has both high- and low- corruption links, no state capture occurs.

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Such a pattern suggests occasional weaknesses of the integrity framework without an extensive breakdown of institutional autonomy.

In the bottom left panel (iii), corruption is organised along the lines of clusters of contracting organisations with one cluster (C_1) containing only high corruption contracts while the other cluster (C_2) contains only low corruption contracts. In this situation, public organisations I_1 and I_2 are likely to have lost all of their institutional autonomy in disbursing public funds through public contracting, while I_3 and I_4 have managed to maintain their contracting autonomy. Because some public organisations are captured while others are not, this state can be denoted as a partially appropriated state (Wedel 2003). If cluster C_1 had consisted of only one public organisation, it could have been denoted as local capture. As the cluster already contains two public organisations it represents a position somewhat removed from local capture and closer to global capture.

In the bottom right panel (iv), every contract is of high corruption risk, rendering the state fully captured, or, to put it another way, the network exhibits global capture. As there are two separate contractual networks, the network configuration suggests an oligarchic structure whereby different captor groups target different sets of organisations. Nevertheless, this would need to be confirmed by analysis of the personal networks of key office-holders in the clustered organisations. It is possible that the absence of a contractual link is the result of market and/or geographic separations while personal ties assure a single captor group.

The four above types are of a highly simplified nature compared to the empirical data we analyse. There are three notable extensions to these models: first, clusters are unlikely to be completely separate, but rather are likely to be characterised by a dense network of intra-cluster contractual links, but some sparse relations among clusters. Second, clusters may only differ in the degree of corruption risk associated with their intra-cluster contractual relationships; that is, some clusters are expected to have dominantly high corruption-risk

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contracts while others dominantly low corruption-risk contracts. Third, our indicator of corruption risks (CRI) of contractual relations is not binary but rather a continuous measure, making the analysis much more fine-tuned than the simple binary categorisation of contracts.

Using the above conceptualisation of state capture, this article investigates the relationship between governing elite composition and the structure of state capture. The starting point is that in a typical case, captor groups have different degrees of centralisation, some resemble a loose coalition of diverse actors (i.e. oligarchy), others a highly centralised group with a strict hierarchical structure (i.e. hierarchy). Internal organisation determines the degree to which they are capable of collective action such as managing rent extraction. Hence, we can hypothesize that captor groups organise rent extraction in line with their internal composition. That is, decentralised captor groups would organise rent extraction in public procurement in a decentralised way. This is reflected in the organisational network consisting of multiple distinct clusters of high corruption organisations. A centralised captor group would organise rent extraction in public procurement in a centralised way. This would be reflected in the organisational network as a tightly knit cluster occupying the centre of the graph. Since the composition of the elite in Hungary changes radically (i.e. becomes centralised) in 2010 following the landslide victory of the conservative party (Fidesz), this provides an appropriate testing ground for theory. In this context, the competing hypotheses to be tested are:

H_0: Elite centralisation of 2011-2012 did not change the central position of captured organisations;

H_1: Elite centralisation of 2011-2012 made captured organisations more central in the network.

3. THE DATA

3.1. Public procurement data from Hungary, 2009-2012

The database derives from Hungarian public procurement announcements from 2009-2012 (this database is referred to as PP henceforth). The data represent a complete database of all public procurement procedures conducted under Hungarian Public Procurement Law. PP contains variables appearing in 1) calls for tenders, 2) contract award notices, 3) contract modification notices, 4) contract completion announcements, and 5) administrative corrections notices. As not all of these kinds of announcements appear for each procedure, we only have the variables deriving from contract award notices consistently across every procedure. Comparable datasets exist or can be constructed from public records in most developed countries including every EU member state, Russia, and the US at least since 2008.

These documents are published online in the Public Procurement Bulletin[1]. As there is no readily available database, we used a crawler algorithm[2] to capture the text of every announcement. Then, applying a complex automatic and manual text mining strategy, we created a structured database that contains variables with clear meaning and well-defined categories. As the original texts available online contain a range of errors, inconsistencies, and omissions, we applied several correction measures to arrive at a database of sufficient quality for scientific research. For a full description of database development, see Fazekas and Tóth (2016). The database is downloadable at digiwhist.eu/resources/data.

A potential limitation of our database is that it only contains information on public procurement procedures administered under the Hungarian Public Procurement Law as there is no central depository of other contracts. The law defines the minimum estimated contract value for its application depending on the type of announcing body and the kind of products

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[1] See: http://www.kozbeszerzes.hu/nid/KE (in Hungarian)
[2] For a gentle introduction see: http://en.wikipedia.org/wiki/Web_crawler

or services to be procured (for example, from 1 January 2012, classical issuers have to follow the national regulations if they procure services for more than 8 million HUF or 27 thousand EUR). Hence PP is a biased sample of total Hungarian public procurement, containing only the larger and more heavily regulated cases. This bias makes PP well suited for studying more costly and high-stakes corruption, since coverage is close to complete. In spite of any such limitations, a large amount of data is available: over 53,000 contracts awarded worth over 11 billion EUR, amounting to over 3% of total GDP in 2009-2012 (Table 1)

3.2 Network data from Hungary, 2009-2012

This public procurement database allows for very detailed and complex network analyses as there are at least three distinct actors recorded: 1) public organisations or issuers, 2) private organisations or suppliers/winners, and 3) procurement advisors or brokers. Networks can be constructed with contracts defining ties between actors, but other links are also possible such as co-participation in a bid or consortium, issuers procuring together, shared company ownership, or a shared set of managers or board members. The fact that the database records transactions on a daily basis opens up the possibility of a wide range of analyses.

In order to concentrate on the aspects of the available rich dataset most relevant to research goals, a subset of actors and relationships between them (edges or ties) was selected for analysis   (

Table 2). First, only two types of actors were selected resulting in a two-mode or bipartite network structure: issuers and winners. While there has been a lot of scientific discussion about the crucial role of informality and the consequent secondary importance of formal structures, public as well as private organisations still represent specific investments into means of rent extraction for corrupt groups. By implication, network analysis focusing on organisational networks is capable of capturing the most relevant means and structure of high-level rent extraction and corruption. Second, the analysed database only records contracts of at least 1 million HUF (or roughly 3300 EUR)[3]. Below this threshold, contracts are considered to be too small for high-level politics to interfere (though this does not mean that there is no corruption involved in their award). Third, only those organisations are analysed which have at least three contracts awarded in at least one of the two observation periods as the market behaviour of organisations with less than three contracts in a roughly one-and-a-half year period is generally too erratic creating random noise which inhibits pattern identification. This is also true for the calculation of the CRI of each transaction, by implication network data and corruption measurement both refer to the same sample.

In order to harness the changing elite configuration resulting from the change of government in May 2010, two roughly equal time periods were selected: 1/1/2009 – 31/4/2010 capturing the socialist government's almost one-and-a-half years in office and 1/1/2011 – 31/7/2012 capturing the first roughly one-and-a-half years of the conservative government in office. Note that the immediate period after the change of government (1/5/2010 – 31/12/2010) is excluded from the analysis as it is considered to be transitory. This is because public procurement tenders often have around a half-year time span between launch and final contract award and incoming governments typically take a few months to establish their new

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[3] Note that this threshold is below the mandatory publication threshold. This is because we applied a threshold of contracts, while the regulation refers to tender values (one tender can have multiple contracts awarded).

regime in public procurement such as implementing new rules and appointing new officials to key posts.

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Table 2, the number of edges is lower than the number of contracts as any pair of organisations could have concluded more than one contract in each period. Multiple contracts between the same two actors within each period were aggregated to represent one edge per period, i.e. a single relationship between actors.

The two networks are by and large of the same size with the network representing the 2011-2012 period containing somewhat more edges and actors, but much smaller total contract value. This is because public procurement spending greatly decreased after the 2010 elections reflecting budget cuts across the whole public sector.

The two periods are treated as two distinct networks not only because the underlying governing elites have almost completely changed, but also because the organisational actors and their positions changed fundamentally. Only about one-third of organisations are present in both networks (Table A1), with suppliers displaying a particularly low level of overlap between the two periods. These statistics are broadly in line with interview evidence pointing at a wholesale restructuring of the public procurement market under the new conservative government. In addition, the network position of organisations present in both networks changed considerably.

We can claim that elite configuration under the two periods is fundamentally different as both the governing parties have different internal organisation and the public administration structures they created are very different. The socialist governments between 2002 and 2010 consisted of a coalition of the socialist party (MSzP) and the liberal party (SzDSz) with three different prime ministers in the period. The party leadership has changed on multiple occasions in this period. The conservative party (Fidesz) formed a government de facto on its own in 2010 commanding two-thirds parliamentary majority, while the party has always been led by three-time prime minister Viktor Orbán. Although party and government leadership turnover and coalition governments are far from the only indicators of governing elite

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centralisation, they both point in the same direction. The socialist governing elite was a more decentralised elite group than the conservative governing elite.

This picture is further strengthened by the centralisation of the public administration under the conservative government. There was a strong centralising push in public services in 2010-2012 through the reallocation of many locally managed services, such as primary and secondary education, and associated spending, to the centre (OECD 2011, 2015). In a similar vein, most local public services - such as issuing permits - which had previously been managed by municipalities were transferred to regional or national centres. Finally, the central government was reorganised into only eight ministries with three 'top' ministries managing most substantial areas. This move was openly praised by top government officials as a means to effective governance. Even though reorganising the state serves only as a proxy for elite configuration and elite preferences, it clearly points at a more centralised direction under the conservative government when compared with the previous socialist government.

4. MEASURING INSTITUTIONALISED GRAND CORRUPTION: FOCUSING ON THE CONTRACTS BETWEEN TWO ORGANISATIONS

The starting point for identifying state capture is to develop a robust measure of institutionalised grand corruption at a dyadic level; that is by looking at the relationship between any pair of issuers and winners. The approach follows closely the composite indicator building methodology developed and tested by earlier scholarship making use of a wide range of public procurement 'red flags' (Charron et al. 2016; Fazekas, Tóth, and King 2016).

The measurement approach exploits the fact that for institutionalised grand corruption to work, procurement contracts have to be awarded recurrently to companies belonging to the corrupt network. This can only be achieved if legally prescribed rules of fair competition and open access to public resources are circumvented. By implication, it is possible to identify the

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input side of the corruption process, that is techniques used for limiting competition (e.g. leaving too little time for bidders to submit their bids), and also the output side of corruption, that is signs of limited competition: single bid received and recurrent contract award to the same company. By measuring the degree of unfair restriction of competition in public procurement, a proxy indicator of corruption can be obtained. This indicator, which we call the Corruption Risk Index (CRI), represents the probability of particularistic contract award and delivery in public procurement falling between 0 and 1 (minimal and maximal corruption risk respectively). Based on qualitative interviews of corruption in the public procurement process in Hungary as well as a review of the literature (OECD 2007; Pricewaterhouse Coopers 2013; World Bank 2009), we identified the components of the CRI, that is 'red flags' indicating corruption risks in public procurement (Table 3).

Each of these is discussed briefly here:

- One of the most straightforward 'red flags' of corruption is that only a single bid is submitted. Since we are only examining competitive markets, the apparent lack of competition allows for awarding contracts above market price and extracting corrupt rents.

- A simple way to fix tenders is to avoid the publication of the call for tenders in the official public procurement journal as this makes it harder for competitors to learn about business opportunities and hence to prepare a bid.

- While open competition is relatively hard to avoid in some tendering procedure types, such as open tender, others such as invitation tenders are by default less competitive; hence the selection of a less open and transparent procedure type can also indicate the deliberate limiting of competition, and hence corruption risks.

- Eligibility criteria define which companies are allowed to bid. Tailoring the conditions to a single company is one of the most widely quoted means for corruptly

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limiting competition. Overly complex, hence lengthy criteria, are a typical sign that criteria were 'over-specified', most likely excluding competitors.

- If the submission period, i.e. the number of days between advertising a tender and the submission deadline, is too short for preparing an adequate bid, it can serve corrupt purposes; whereby the issuer informally tells the well-connected company about the opportunity much earlier.

- To prepare bids, bidders need to access the full tender documentation for which they are sometimes required to pay a fee. Excessively expensive tender documentation can be used for corrupt purposes, as it can deter otherwise competitive bidders, especially smaller ones reluctant to take larger risks.

- 'Call for tender' announcements provide the key document for bidding firms on which to base their bids. However, changes - once or multiple times - to the bidding conditions, such as technical content or eligibility criteria, may signal corruption risk as this creates uncertainty and may deter bidders.

- While receiving more than one bid indicates lower risk of corruption in public procurement, abusing administrative rules for excluding bidders can still serve corrupt purposes, especially when all but one bidder is excluded. Typically, the reasons for such exclusions are insubstantive, such as missing page numbers or the absence of an official stamp on an auxiliary document.

- Different types of evaluation criteria are prone to fiddling to different degrees. Subjective, hard-to-quantify criteria often accompany rigged assessment procedures as these create room for discretion and inhibit accountability mechanisms.

- When the size and sector of the contract mandates an open procedure, a widely used corruption technique avoids open competition by deliberately derailing the first open procedure and re-launching the tender under an accelerated, less open procedure type ,citing the urgency of purchase and the time lost in the unsuccessful first open tender.

- If the time used for deciding on the submitted bids is excessively short or lengthened by legal challenge, it can also signal corruption risks. Snap decisions may reflect premediated assessment, while legal challenge and the corresponding long decision period suggests outright violation of laws.

- Most 'red flags' of corruption in public procurement concentrate on the bidding process, however, the contract implementation phase is even more prone to corruption due to frequent lack of attention and clear information. Modifications to contract conditions signal the risk of unfair competition and corruption (i.e. non-connected bidders could not have foreseen the loosening of contract conditions when bidding). Increasing the contract value and postponing delivery dates are two particularly high-risk signals.

- On competitive markets, it is unlikely to have the same company winning all the contracts of a given issuer, hence the share of the winning company within all the contracts awarded by the issuer can indicate rigged competition.

Single bidder and winner's contract share are two outcomes of the competitive process which closely match the concept of institutionalised grand corruption in addition to having been identified as the most reliable 'red flags' in the literature. However, under the strict rules of open competition dictated by public procurement laws, the rules of the game have to be rigged to favour well-connected bidders. This gives rise to 'red flags' of the tendering process in conjunction with high-risk tendering outcomes.

For continuous variables above such as the length of submission period, thresholds had to be identified in order to reflect the non-linear character of corruption. This is because most values of continuous variables can be considered as reflections of diverse market practices (e.g. 20 or more days for bidders to prepare their bids), while some domains of outlier values are more associated with corruption (e.g. only allowing five days for bid submission).

Thresholds were identified using regression analysis, in particular analysing residual distributions.

We restricted the sample to experienced issuers of tenders on competitive markets in order to minimize the chances that we are measuring honest errors or inexperience rather than corrupt practices. Thus we only examine tenders in markets with at least three unique winners throughout 2009-2012, where markets are defined by product type (CPV[4] level 3) and location (NUTS[5] level 1); and issuers that have awarded at least 3 contracts in the 12 months period prior to the contract award in question.

In addition to the identification of thresholds in continuous variables, regression analysis was used to ensure that 'red flags' measure corruption, and to make the indicators comparable across different sectors and regions (where different corruption techniques might be used). In this analysis, we consider 'red flags' as indicating corruption only if they predict (1) single bidder contracts and (2) winner contract share in the 12 months prior to contract award. We control for a number of likely confounders in these regressions. These controls are: (1) administrative capacity measured by number of employees of the issuer[6], (2) institutional endowments measured by type of issuer (e.g. municipal, national), (3) product market and technological specificities measured by CPV division of products procured, (4) number of competitors on the market measured by the number of unique winners throughout 2009-2012 on CPV level-3 product group and NUTS-1 geographic region, (5) contract size and length, and (6) regulatory regime as proxied by year of contract award.

Some examples show the logic of analysis and our approach to interpretation (for full details see: Fazekas, Tóth, and King 2016). Failing to publish the call for tenders in the official

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[4] CPV=Common Procurement Vocabulary. For more info see: http://simap.europa.eu/codes-and-nomenclatures/codes-cpv/codes-cpv_en.htm
[5] NUTS=Nomenclature of territorial units for statistics. For more info see: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction
[6] Employment data derives from national administrative databases.

journal increases the average probability of single received and valid bids by 12.1-14.0%; and it also increases the winner contract share in all contracts awarded by the issuer in the previous 12 months by 3.9%. These results suggest that avoiding the transparent and easily accessible publication of a new tender can typically be used for limiting competition to recurrently benefit a particular company. This implies that a call for tenders not being published in the official journal should be included in CRI. Similarly, leaving only five or fewer days, including the weekend, for bidders to submit their bids is associated with a 21.2% higher probability of a single bidder contract and with a 7.7% higher winner's contract share compared to submission periods longer than 20 calendar days. These indicate that extremely short submission periods are often used for limiting competition and awarding contracts recurrently to the same company. These provide sufficient grounds for including this in the CRI.

Following from the regression analysis each valid 'red flag' of corruption is identified and included in CRI. In addition to the outcome variables of the two regressions (single bidder and winner contract share) all those variables are included in CRI which are in line with a rent extraction logic hence proven to be significant and powerful predictors in both regressions.

Once the list of elementary corruption risk indicators is determined with the help of regression analysis, each of the variables and their categories receive a component weight (Table A2). As we lack the detailed knowledge of which elementary corruption technique is a necessary or sufficient condition for corruption to occur, we assign equal weight to each variable and the sizes of regression coefficients are only used to determine the weights of categories within variables. For example, if there are four significant categories of a variable, then they are weighted 1, 0.75, 0.5, and 0.25 reflecting category ranking according to

coefficient size. The component weights are normed so that the observed CRI falls between 0 and 1.

As CRI is defined on the level of individual public procurement tenders, it is most appropriately used as the edge weight in the organisational contractual network. As any two organisations can have more than one contract linking them within the same period, edge weights were calculated as the unweighted arithmetic average of the contracts constituting the edge between the actors in the period considered.

In order to establish that CRI proxies corruption rather than other phenomena such as low administrative capacity, its co-variation with five different external indicators is explored (Fazekas, Tóth, and King 2016). All the performed tests are confirmatory: significant and point   in   the   expected   direction   (

Table 4). Winning companies with the highest profit margins have 0.024 higher CRI than low profit-margin winning firms. Expensive purchases display a 0.071 higher CRI than the cheapest purchases. Both of these suggest that CRI captures institutionalised corrupt rent extraction resulting in higher profits from above market procurement prices. Companies with direct political connections have 0.011 higher CRI than companies without such ties, similarly companies whose market success is fundamentally altered by the change of government display 0.011 higher CRI than companies whose success was unaffected by the government change. While the difference of 0.011 CRI is of moderate magnitude, it indicates that high-level politics is associated with corruption risks measured by CRI. Public procurement winning firms which are registered in tax havens as measured by the Financial Secrecy Index (Tax Justice Network 2013) have 0.02 higher CRI than companies registered in transparent jurisdictions.

5. IDENTIFYING STATE CAPTURE PATTERNS: FOCUSING ON CONTRACTUAL NETWORKS

This section makes the leap from corruption in binary contractual relationships to state capture defined by organisational clusters underpinning collective action by captor groups. This entails, first, exploring the total contractual network in order to establish stylised facts in line with the hypothesized network formations (Figure 1); second, performing a cluster analysis using the corruption risks present in organisations' ego networks (i.e. immediate neighbours in the network); and third, mapping the network position of captured and clean organisations identified by the prior cluster analysis. Network analysis and visualisation were conducted using R's igraph package, Python's NetworkX library and Gephi.

The contractual networks of both periods are fundamentally similar with no substantive difference in elementary network summary statistics (Table A3). For example, network density, that is the proportion of observed ties compared to all possible ties, is 0.004 for

2009-2010 and 0.003 for 2011-2012; hardly any change. This underlines the continuity of government contracting in spite of radical change in the structure of government since 2010.

In order to directly project the stylised network configurations onto the empirical data, high and low corruption-risk contracts were denoted as those with the highest 20% CRI scores and those with the lowest 20% CRI scores respectively. The contracts with CRI scores around the mean were excluded from the representation. The resulting graph for the 2009-2010 period is in Figure 2. Red vertices represent suppliers and green vertices denote issuers. Node size reflects degree centrality (i.e. total number of direct relations a node has taking weights into account) and node location is a function of network closeness using the Fruchterman-Reingold layout function. Edge width reflects corruption risks (CRI) of the contracts underlying each edge (average CRI edges while excluded from the representation were still used for calculating network distance). Underpinning the hypothesized network formations, there are a few clusters of organisations which tend to be linked either by low or high corruption-risk edges while many more have mixed relationships, both high and low CRI. This simple visualisation motivates the formal cluster analysis of organisational ego networks in order to identify clean as well as mixed cases of capture.

We clustered supplier and issuer organisations based on each organisation's average CRI and the relative standard deviation of CRI (clustering procedures carried out with Stata 12.0: cluster command). The first clustering variable captures the overall level of corruption risks in an organisation, while the second indicates how consistently the organisation behaves. Thus, clustering based on these two variables allowed to capture the degree to which each organisation's ego network fits the homogenous or heterogeneous corruption patterns hypothesised. While the above theory suggested clean, fully captured and mixed clusters, the

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clustering algorithms[7] instead revealed four groups with two intermediate cases instead of one[8] (Table 5):

- Clean organisations: low average corruption with low variability of performance;

- Occasionally corrupt organisations: low average corruption with highly variable performance indicating that there are occasional deviations from the low corruption standard contracting practice;

- Partial capture: high average corruption with high variability indicating that there are still low corruption contracts which, nevertheless, represent the deviation from a high corruption norm.

- Full capture: high average corruption with low variability of performance indicating that corrupt exchanges represent the norm in the organisation's contracting practice.

Comparing the two periods, there is no considerable difference in terms of proportions of each group: about 60% of organisations are partially or fully captured in Hungary (Table A4). This is a surprisingly high figure, but it also signals that the Hungarian state is not fully captured, but rather that there is a range of organisations with mixed track records. This indicates that the norm of ethical universalism is only partially established and there are organisations where opposing norms conflict.

After establishing that there is a considerable degree of organisation-level capture in Hungary, the final step is to gauge the degree of state capture at the inter-organisational level. Hence, we search for communities or cohesive sub-groups in the whole network which denote groups of contracting entities and winning firms which are more densely connected to

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[7] We first implemented a hierarchical clustering procedure to identify the optimal number of clusters simultaneously for both periods (relying on Calinski/ Harabasz pseudo-F and Duda/Hart indices). Final clusters were identified implementing k-means clustering. Euclidian distance was used. Hierarchical clustering indices are reported in Appendix B.
[8] The three cluster solution is only slightly less preferable to the four cluster division which nevertheless only marginally influence the substantive conclusions as the extreme categories (i.e. clean and captured) are of key interest.

each other than to the rest of the network. In order to identify such communities, we employ a so-called modularity measure which measures how good a given community definition is by comparing the number of links within each community compared against the expectation of a random but comparable network[9]. The more links stay within the community relative to the outside world, the greater the modularity (and the more separated various communities are in the graph). This approach applied to the public procurement contracting network of Hungary (2009-2010) highlights the existence of distinct cohesive sub-groups (Figure 3).

The existence of some cohesive sub-groups is not a surprise given the strong geographical and market-driven patterns in government contracting. However, what is surprising and points heavily towards state capture at the level of communities is that there are a number of communities which predominantly consist of organisations earlier denoted as partially or fully captured (in 2009-2010, 32% of organisations belong to a community where captured organisations make up more than two-thirds). These are organisations which are not only captured based on the corruption risks in their own contracting activities, but they also extensively contract among themselves rather than with organisations outside their captured community. Formal tests confirm that community membership and belonging to the captured or non-captured organisation types are significantly associated (for 2009-2010, Pearson's chi2 and likelihood ratio chi2 tests are significant at the 0.001 level, Cramer's V=0.2).

In Hungary, where some degree of state capture is expected (Innes 2014), the proposed methodology identified and precisely located this phenomenon on the organisational level as well as in relation to groups of organisations. The findings reveal a graduated and dynamic picture instead of traditional, rather monolithic approaches to state capture: there are varying degrees of capture at the organisational level, there are different network formations of

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[9] A random, but comparable network was obtained by randomly re-allocating the ties between nodes, while preserving the structural characteristics of the network such as number of nodes or the degree distribution (number of ties each node has).

captured organisations with some forming densely connected communities, and these fundamental patterns of state capture dynamically change from 2009-2010 to 2011-2012 when a new government comes to power.

6. LINKING STATE CAPTURE PATTERNS TO ELITE CONFIGURATION

While the previous section demonstrated the logic of measuring state capture in government contracting based on the network structure of corrupt transactions and actors, here we apply the framework to explore a simple hypothesis: The elite centralisation of 2011-2012 in Hungary made captured organisations more central in the network (H_1). The aim is merely to demonstrate the capacity of the proposed approach to contribute to hypothesis testing.

In order to formally test the centralisation hypothesis, we look at how network position is associated with corruption risks as well as how organisational clusters are located at different network positions in the two periods. We use two intuitive concepts to gauge network position: closeness centrality and local clustering coefficient (Borgatti, Everett, and Johnson 2013; Opsahl 2013). Closeness centrality captures how far a given node is from all other nodes, as a node in the centre of a graph is the one with the shortest distance from the rest of the graph. Local clustering captures the density of connections in any given node's immediate network.

First, we regressed closeness[10] and local clustering on CRI while controlling for organisation type and number of contracts awarded or received (

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[10] We used normalized closeness in R in order to control for the slight differences in the two networks such as overall size.

Table 6)[11]. Results point at the non-linear and changing relationship over time between closeness centrality and corruption risks (models 1 and 3). Closeness became a stronger predictor of CRI in 2011-2012 than in 2009-2010 with the upward sloping linear component becoming more than 5-times larger and the negative quadratic component also increasing in magnitude (See Appendix C for graphical representations of these changing non-linear relationships). The association between local clustering and CRI changes even more distinctively, while the relationship is significant positive in 2009-2010, it turns into very small insignificant in 2011-2012. Taken together[12], the change of government changed the relationship between network position and corruption risks. On the one hand, 2009-2010 was characterised by densely connected sub-centres being the most corrupt, with central nodes being less corrupt. On the other hand, 2011-2012 was characterised by sub-centres without any distinct corruption risk level, and central nodes becoming relatively more corrupt even though they remained less corrupt than the periphery. These associations, while very elementary and explaining only some of the total variance, lend some support to hypothesis H_1 with centralisation and the break-up of local corruption clusters when the government changes. They also coincide with qualitative accounts of how the prime minister entering office in 2010 increasingly centralised decisions over government contracts, carefully sharing all major projects among two or three of his closest associates.

Second, we directly utilize the identified state capture formations by mapping organisational clusters'   average   network   position   (

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[11] The regressions are run on a restricted sample excluding all the disconnected tiny sub-graphs as their network characteristics are atypical, and they can bias closeness measures (Opsahl, Agneessens, and Skvoretz 2010). For 2009-2010 4%, for 2011-2012 6% of the nodes were removed.

[12] Closeness and clustering weren't entered at the same time in the regressions as they are highly collinear.

Table 7). The above arguments in favour of H_1 are further underpinned by the decreasing local clustering of the clean organisation type, i.e. non-captured organisations became more dispersed across the whole network. Average closeness decreased markedly from 2009-2010 to 2011-2012, with fully captured organisations decreasing in their average closeness the least, i.e. in terms of their relative position in the network, they became more central.

7. CONCLUSIONS AND FURTHER WORK

The discussion and analysis so far have pointed out the feasibility and usefulness of measuring corruption using transaction-level public procurement data and linking this corruption indicator to state capture. Further validating work should shed more light on the reliability and validity of this approach. Applying the measurement framework to a straightforward research problem provided further evidence for its relevance, although it was not possible to extensively test the centralisation hypothesis.

Regarding the causal link between elite composition and the structure of state capture, there is a crucial limitation. It is unclear to what degree the centralisation of corruption and state capture is the function of the reorganisation of the public administration or the governing elite structure. These two events would have equivalent consequences in network terms and they happened at the same time. However, differentiating the two causal pathways is irrelevant as long as the main concern is the change in state capture and the consequences it has for the society. In addition, as CRI primarily measures outright corruption and lack of competition, more sophisticated, organised forms of corruption remain largely undetected. If the structure of state capture and network position of corrupt transactions are related to the sophistication of corruption techniques, our results are likely to be biased.

State capture is established daily practice in approximately 60% of public sector organisations conducting public procurement in a relatively well-governed middle-income country, Hungary. Providing large amounts of external funding such as EU Funds in such a

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governance context is likely to further increase rents extracted and captor groups' capacity to compromise good governance. The systemic and networked nature of political corruption makes any administrative fixes to corruption likely to fail. Instead, a big-bang approach to anticorruption, i.e. simultaneous reforms in every major policy area, may be a more realistic strategy (Rothstein 2011).
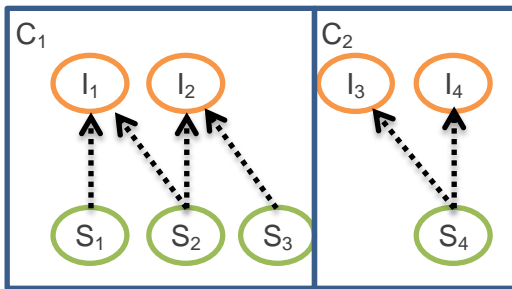
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FIGURES

Figure 1. Typical network configurations of corruption and state capture
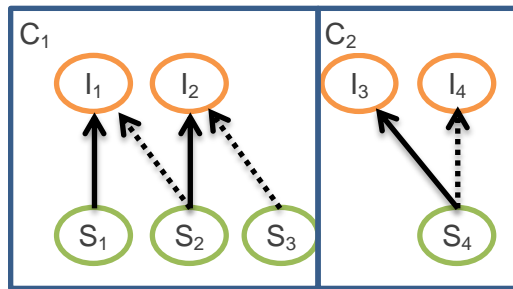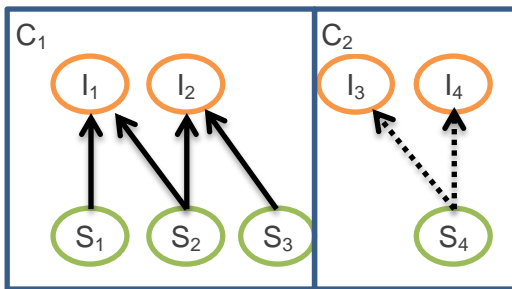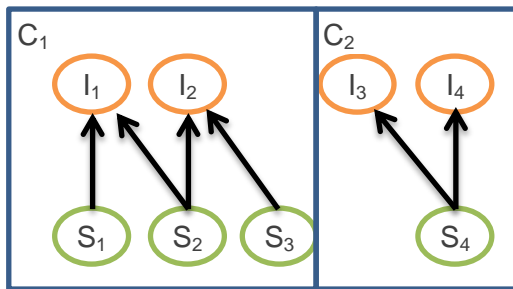
Note: dashed lines indicate low corruption risk contracts, solid lines indicate high corruption risk contracts

Figure 2. Contractual network using low and high CRI contracts only, Hungary, 2009M1-2010M4

Source: PP

Figure 3. Contractual network of organisations highlighting cohesive subgroups with highest modularity, Hungary, 2009M1-2010M4
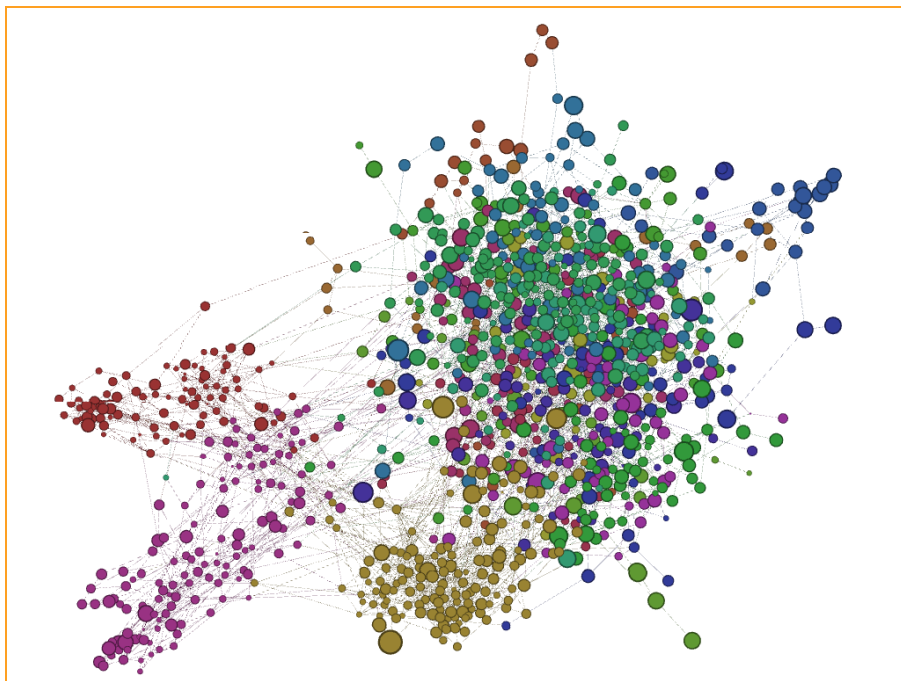
Source: PP

Note : node colours represent membership in distinct cohesive sub-groups, node size scales linearly in CRI, and the layout is generated by the ForceAtlas2 algorithm in Gephi. Vertices repulse one another like magnets or charged particles, while edges, like springs, pull together the vertices they connect. Strongly connected groups of vertices tend to bunch. spatial distance reflects distance in the network

TABLES

Table 1. Main statistics of the analysed data – contracts

	2009	2010	2011	2012	**Total**
Total number of contracts awarded	10918	17914	14070	10342	53244
Total number of unique winners	3987	5617	5587	4923	13557
Total number of unique issuers	1718	2871	2808	2344	5519
Combined value of awarded contracts (million EUR) *	4604	3834	1856	1298	11592

Source: PP

*Notes: * = a 300 HUR/EUR uniform exchange rate was applied for exchanging HUF values.*

Table 2. Descriptive statistics of network sizes of the two periods, 2009-2010 and 2011-2012

	N contract	N issuer	N winner	N edge	total contract value (million EUR)*
2009-2010M4	8121	887	1244	5365	2,089.75
2011-2012M7	7748	973	1491	5602	991.44

Source: PP

*Notes: * = a 300 HUR/EUR uniform exchange rate was applied for exchanging HUF values.*

Table 3. Summary of corruption inputs (higher score indicates greater likelihood of corruption)

phase	indicator name	indicator definition
submission	Single bidder contract*	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=invitation procedure 2=negotiation procedure 3=other procedures (e.g. competitive dialogue) 4=missing/erroneous procedure type
	Relative 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 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
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)

* The single bidder indicator is simultaneously an outcome of the submission phase and an input to the assessment phase.
** Combining annulations by the issuer and the courts

Table 4. Summary of validity tests using external indicators, significant relationships (p<0.001)

indicator	reference group	comparison group	CRI diff.
winner annual profit margin	profit margin<1.44	profit margin>5.15	0.024
ratio of contract value to estimated contract value	price ratio<0.9	0.9<price ratio<1	0.071
political connections of winning firms	politically NOT connected companies	politically connected companies	0.011
government dependent market success of firm	NOT government dependent company success	government dependent company success	0.011
firm registered in tax heaven	FSI<=58.5	FSI>58.5	0.020

Note: Significance levels computed using Monte-Carlo random permutations with stata

Table 5. Clusters' mean value of the clustering variables, Hungary, 2009-2012

cluster/stat	2009M1 – 2010M4		2011M1 – 2012M7	
	CRI(stand.)	Relative st.dev.of CRI	CRI(stand.)	Relative st.dev.of CRI
clean	0.268	0.103	0.226	0.117
occasional corruption	0.242	0.517	0.240	0.481
partial capture	0.304	0.304	0.314	0.282
full capture	0.549	0.140	0.459	0.119
Total	0.332	0.260	0.312	0.244

Source: PP

Table 6. Linear regressions on average organisational CRI, coefficients and t values are reported, Hungary, 2009-2012

Model number	1	2	3	4
	2009-2010		2011-2012	
independent vars./dependent var.	CRI	CRI	CRI	CRI
closeness	119917***		675949***	
closeness squared	-4756869***		-51838809***	
local clustering coefficient		0.159***		0.00598
type of organisation=supplier	0.0014	-0.00784	-0.0211***	-0.0354***
nr. of contracts awarded/won	0.00095***	0.00036**	0.00047**	-0.000933***
constant	-755***	0.223***	-2203***	0.308***
N	2052	2052	2313	2313
R2	0.426	0.0345	0.331	0.037

Source: PP

Note: significance test obtained using Monte-Carlo random permutation simulations with stata 12.0 (300 permutations); * p<0.05, ** p<0.01, *** p<0.001

Table 7. Average centrality and clustering indices per cluster, Hungary, 2009-2012

	2009-2010		2011-2012	
	closeness	local clustering	closeness	local clustering
clean	0.01284	0.24	0.00658	0.18
occasionally corrupt	0.01286	0.15	0.00658	0.26
partial capture	0.01285	0.14	0.00658	0.16
full capture	0.01279	0.26	0.00656	0.25
total	0.01284	0.19	0.00658	0.2

Source: PP

(ONLINE) APPENDIX A – ADDITIONAL TABLES

Table A1. Overlap of organisations in the networks of the two periods, Hungary, 2009-2012

periods	N			%		
	total	issuers	suppliers	total	issuers	suppliers
2009-2010 only	1,057	381	676	30.02	28.14	31.2
2011-2012 only	1,392	469	923	39.53	34.64	42.59
both periods	1,072	504	568	30.45	37.22	26.21
Total	3,521	1,354	2,167	100	100	100

Source: PP

TableA2. Component weights of CRI reflecting variable and category impact on corruption outcomes, normed to have an overall sum of 1

Variable	component weight
single received/valid bid	0.096
no call for tenders published in official journal	0.096
procedure type	
ref. cat.=open procedure	0.000
1=invitation procedure	0.048
2=negotiation procedure	0.072
3=other procedures	0.096
4=missing/erroneous procedure type	0.024
relative length of eligibility criteria	
ref.cat.=length<-2922.125	0.000
1= -2922.125<length<=520.7038	0.024
2= 520.7038<length<=2639.729	0.048
3= 2639.729<length	0.072
4= missing length	0.096
short submission period	
ref.cat.=normal submission period	0.000
1=accelerated submission period	0.048
2=exceptional submission period	0.072
3=except. submission per. abusing weekend	0.096
4=missing submission period	0.024
relative price of tender documentation	
ref.cat.= relative price=0	0.000
1= 0<relative price<=0.0004014	0.000
2= 0.0004014<relative price<=0.0009966	0.096
3= 0.0009966<relative price<=0.0021097	0.064
4= 0.0021097<relative price	0.032
5=missing relative price	0.000
call for tenders modification(only before 01/05/2010)	0.096
weight of non-price evaluation criteria	
ref.cat.= only price	0.000
2= 0<non-price criteria weight<=0.4	0.000
3= 0.4<non-price criteria weight<=0.556	0.048
4= 0.556<non-price criteria weight<1	0.096
5=only non-price criteria	0.000
procedure annulled and re-launched subsequently	0.096
length of decision period	
ref.cat.= 44<decision period<=182	0.000
1= decision period<=32	0.064
2= 32<decision period<=44	0.032
4= 182<decision period	0.096
5= missing decision period	0.000
contract modified during delivery	0.096
contract extension(length/value)	
ref.cat.= c.length diff.<=0 AND c.value diff.<=0.001	0.000
2= 0<c. length d.<=0.162 OR 0.001<c.value d.<=0.24	0.096
3= 0.162<c. length diff. OR 0.24<c.value diff.	0.000
4= missing (with contr. completion ann.)	0.048
5= missing (NO contr. completion ann.)	0.000
winner's market share	0.096

Source: PP

Note: If the call for tenders or contract fulfilment announcements are missing, the index is reweighted to only reflect the available variables (i.e. proportionately increasing the weight of observed variables).

Table A3. Elementary network descriptive statistics per period, Hungary, 2009-2012

	Density	Avg. Dist.	Diameter	Transitivity.
2009M1-2010M4	0.004	5.284	13	0.277
2011M1-2012M7	0.003	5.449	17	0.263

Source: PP

Table A4. Number and proportions of organisations in the four clusters, Hungary, 2009-2012

cluster/stat	2009M1 – 2010M4			2011M1 – 2012M7		
	N	%	cum. %	N	%	cum. %
clean	447	24.9	25	430	22.3	22
occasional corruption	319	17.8	43	296	15.3	38
partial capture	674	37.6	80	817	42.4	80
full capture	352	19.6	100	381	19.8	100
Total	1,792	100		1,924	100	

Source: PP

(ONLINE) APPENDIX B – CLUSTERING CALCULATIONS

Table B1. Hierarchical clustering: Calinski/Harabasz pseudo-F values, by period

Number of clusters	Calinski/Harabasz pseudo-F	
	2009M1 – 2010M4	2011M1 – 2012M7
2	267.37	94.85
3	433	190.96
4	293.49	141.98
5	225.78	108.23
6	515.16	260.05
7	600.67	282.02
8	521.25	244.14
9	696.64	463.33
10	839.87	604.57
11	795.74	545.44
12	758.92	582.08
13	818.94	587.15
14	776.07	622.9
15	721.61	802.92

Table B2. Hierarchical clustering: Duda/Hart indices, by period

Number of clusters	Duda/Hart		Duda/Hart	
	Je(2)/Je(1)	pseudo T-squared	Je(2)/Je(1)	pseudo T-squared
	2009M1 – 2010M4		2011M1 – 2012M7	
1	0.87	267.37	0.953	94.85
2	0.7709	516.86	0.8748	272.96
3	0.8466	24.46	0.2396	117.41
4	0.5772	35.89	0.3137	26.25
5	0.5991	1072.14	0.7284	696.9
6	0.7278	408.1	0.375	525.1
7	0.6213	26.21	0.33	42.63
8	0.5569	727.33	0.6135	977.74
9	0.4472	629.18	0.6133	668.37
10	0.6169	81.96	0.9611	7.4
11	0.6681	121.72	0.671	240.29
12	0.5381	301.32	0.5231	212.4
13	0.7021	45.82	0.5709	302.84
14	0.0046	216.49	0.5954	594.63
15	0.382	8.09	0.526	98.22

(ONLINE) APPENDIX C – CRI AND CLOSENESS BIVARIATE RELATIONSHIP

Figure C1. Scatterplot and fitted quadratic line of organisational closeness and CRI scores, 2009M1 – 2010M4

Figure C2. Scatterplot and fitted quadratic line of organisational closeness and CRI scores, 2011M1 – 2012M7

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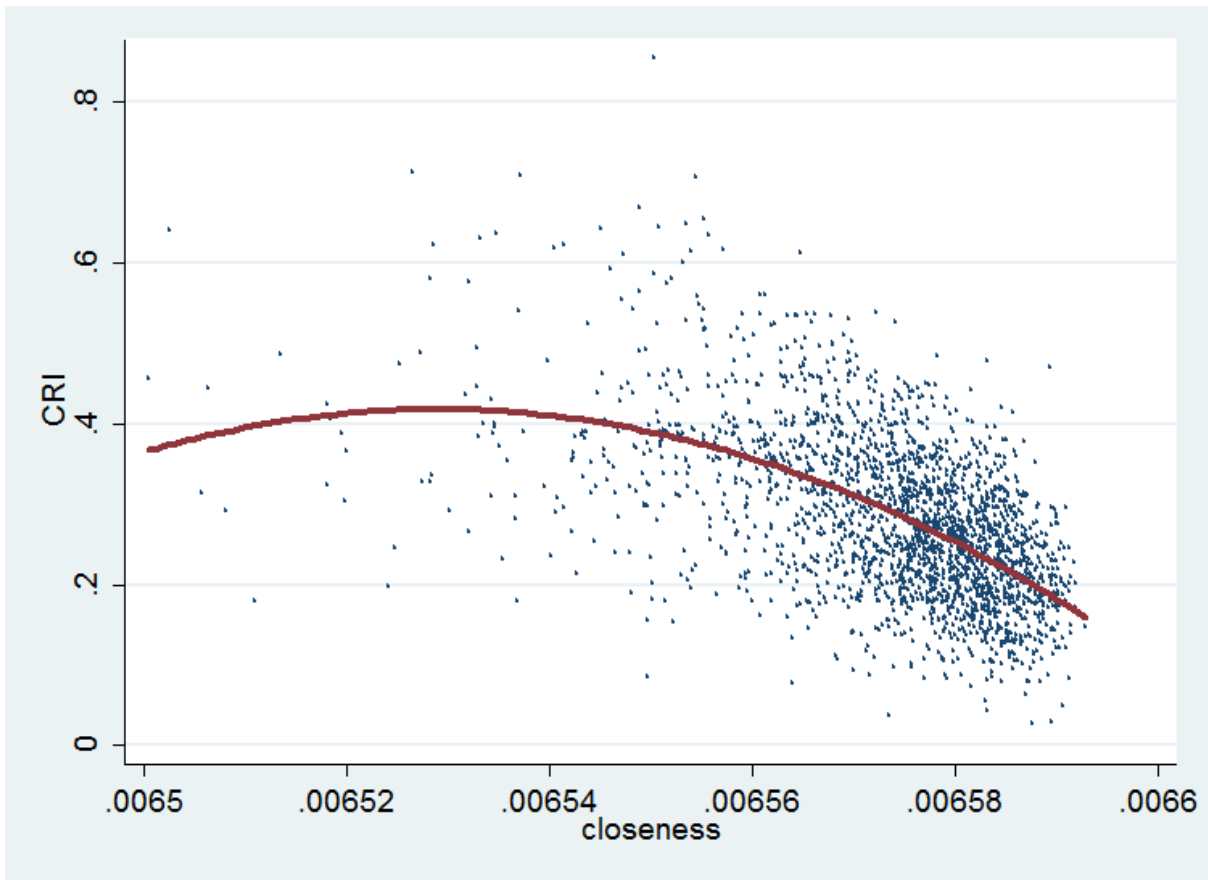
BIOGRAPHICAL PARAGRAPH

Mihály Fazekas completed his PhD at the University of Cambridge in 2014 looking at high-level corruption, state capture, and state capacity in Central- and Eastern Europe. Now, he works at the University of Cambridge as a post-doctoral research fellow at the Department of Sociology as the scientific coordinator of the Horizon 2020 funded project 'DIGIWHIST'. This large-scale research project uses a big data approach to measuring corruption in public procurement and to allowing citizens to hold governments to account. He holds three master degrees in economics, public policy, and teaching. He has experience in both quantitative and qualitative methods in diverse fields such as economics, public policy, and political science acquired in numerous research projects across Europe. He has worked for the OECD, World Bank, RAND Europe, Ecole Nationale d'Administration, Hertie School of Governance, and Hungarian Academy of Sciences. His latest research efforts concentrate on fair competition, transparency, and openness in public procurement markets with particular emphasis on quantitative analysis of corruption risks, bid rigging, and administrative capacity using large-scale administrative databases. Together with István János Tóth, he was awarded first prize in a U4 Anti-Corruption Resource Centre competition for their pioneering work in developing new proxy measures of corruption.