Measuring Regional Quality of Government: The Public Spending Quality Index Based on Government Contracting Data

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ABSTRACT

Government contracting is crucial for defining quality of government and public services as it amounts to about 29% of government spending. However, regional quality of government indicators, especially for public spending, are largely missing. We assess quality of public spending by transparency, competition, efficiency and corruption, using a novel database of 4 million contracts from the EU28 between 2006-2015. We find that public spending quality is associated with GDP/capita, European Quality of Government Index, and public sector meritocracy. We confirm large within-country regional variations, but also find considerable change over time: steady deterioration of performance in old EU member states.

Keywords: quality of government, government contracting, European Union, region

INTRODUCTION

While the importance of institutions in economic development is widely accepted (North et al., 2009), our limited understanding of and measures for the quality of government poses challenges for social sciences and public policy. This challenge is particularly pronounced on the regional level with most measures of government quality looking at the country level (Charron et al., 2015).

Our understanding of the quality of public spending, such as public procurement processes and outcomes, is even more limited due to the lack of specific and reliable measures. This is both surprising and problematic as government contracting plays a crucial role in the development and quality of government across the European Union (EU): it amounts to about 13% of GDP or 29% of government spending (European Commission, 2016; OECD, 2015, 2017) It is a principal means through which governments influence growth rates, the quality of public services, and citizens' well-being. Such lack of measurement limits governments' capacity to pursue developmental objectives such as territorial cohesion through high quality transport links. However, with the increased availability of tender and contract-level public procurement datasets, such as those unlocked by the EU-funded DIGIWHIST project[1], it is finally possible to map and analyse the quality of regional institutions in unprecedented detail.

This article has two main goals. First, it introduces a new dataset and calculates novel indicators characterising EU regions' government quality in 2006-2015, the Public Spending Quality index. Second, it empirically tests theoretical predictions postulating the positive impact of high government quality on socio-economic outcomes. The article makes use of a large-scale administrative dataset of over 4 million government contracts which has not been used in the regional context before. The analysis focuses on public procurement (or government contracting in other words), that is the purchase of goods and services by public entities. It is a genuinely cross-cutting government function concerning virtually every public or semi-public body from federal ministries to local state-owned utilities, making it representative of the quality of government across the whole public sector. Contracts often, albeit my no means always, are of high value in the range of multiple millions of euros spanning over years. Government contracting is also one of the principal means through which governments can influence growth rates and the quality of public services, for example by investing in highways or government IT infrastructure. Hence, indicators based on public procurement data represent a direct measure of transactions key to government quality.

The new measure contributes to the literature, first, by offering indicators of regional quality of government based on objective, administrative data rather than a survey of perceptions of experiences. Second, the availability of millions of contracting records for more than 10 years enables a uniquely detailed assessment on the regional and local levels including NUTS2 and NUTS3 levels[2] but also on the settlement level. Given that the contracts data has precise addresses of buyers, suppliers as well as contract performance, the granularity of regional analysis can be flexibly adjusted to diverse analytical needs.

Third, as the proposed indicators are free of the usual biases and stickiness of governance indicators based on perceptions and self-reported experiences, they are particularly well suited to track changes in regional performance over time. This point is amply demonstrated by the surprisingly steady

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[1] Digiwhist.eu

[2] NUTS=Nomenclature of territorial units for statistics. For more info see: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction

deterioration of government quality in most EU regions with only a handful of exceptions according to our data. Countries are not only diverse within (Charron et al., 2014), but the landscape is shifting on the mid-term, that is in 10-15 years. Fourth, the proposed indicators allow for consistent comparisons not only within countries, but also across countries or regions belonging to different countries; unlike other indicators using objective data (e.g. Golden & Picci, 2005). Fifth, public procurement administrative records are updated on a daily basis by law, so regularly gathering this data and generating the Public Spending Quality indicators is feasible at a modest cost. Continuous monitoring of government quality based on up-to-date data is of particular value for policy makers wishing to trace the impact of reforms. Sixth, given that public procurement data characterises the spending side of government activities, often large value purchases, it is complementary to existing measures of quality of government based on citizen and public service user perspectives.

UNDERSTANDING REGIONAL QUALITY OF GOVERNMENT AND ITS IMPACTS

In order to enhance prosperity, human well-being and the territorial cohesion of the EU, quality of government more broadly and the quality of public spending more narrowly are fundamental preconditions. There are diverse perspectives on what quality of government means (Agnafors, 2013; Fukuyama, 2013; Rothstein, 2014). Some put forward a very broad definition including the modes of access to power, the exercise of power as well as the content of policies (Kaufmann et al., 2009). We side with Keefer (2004) arguing that such a broad definition includes too much limiting our capacity for analysing crucial governance relationships such as the link between government processes and outputs. Given our focus on public spending, we are inclined to adopt a definition for the quality of government which clearly delineates the input side of government that is the access to public authority such as quality of democracy, from the output side of government that is the way in which public authority is exercised. The theory of quality of government as impartiality in the implementation of government laws and policies has gained traction in the social sciences in the last 2 decades (Rothstein & Teorell, 2008). This view about quality of government emphasizes that high quality governments are characterised by impartiality in the distribution of public resources and the lack of corruption. Based on this definition, we set out our measurement below around transparency, open and fair competition, and control of corruption as they are closely related dimensions of impartiality. In addition, we also incorporate administrative efficiency in as much as it relates to timely and balanced public decisions underpinning impartiality in public spending (this also allows us to connect more closely with the European regional policy agenda). The quality of government as impartiality approach puts policy implementation at the heart of the definition rather than the content of policies or the democratic processes through which they are decided. Such a focus enables our indicators to enlighten the relationship between policy content and democratic processes on the one hand and the outcomes of public spending on the other hand.

In addition to rooting our measurement approach in the most relevant academic scholarship, the somewhat broader definition adopted by the European Commission also supports our indicators. The European Commission defines quality of government as: "the absence of corruption, a workable approach to competition and procurement policy, an effective legal environment, and an independent and efficient judicial system," as well as "strong institutional and administrative capacity, reducing the administrative burden and improving the quality of legislation" (European Commission, 2014, p. 161). The advantage of developing a measurement framework which also overlaps with the European regional policy agenda is that it can also be used to design and evaluate regional policies and regional development. Our focus on policy implementation by measuring the quality of public spending in

public procurement further strengthens the utility for European policy making because public procurement represents a major way of implementing regional development policies.

In spite of growing conceptual clarity, measurement of institutional quality suffers from a number of deficiencies. In particular, while there are plenty of indicators on the national level, there is a paucity of regional indicators. Two notable exceptions to this are the European Quality of Government Index (EQI), which was created by the Quality of Government Institute at the University of Gothenburg (Charron et al., 2014), and a more recent measure of meritocracy in the public sector derived from the same regional survey underpinning the EQI (Charron et al., 2016). Such pioneering work amply demonstrates that within country variation is very strong; in many cases, it trumps cross-country variation, hence we can also expect that sub-national public procurement indicators vary considerably within countries. In order to directly tie our novel indicators to the most relevant and already established scholarship, we will cross-check the proposed Public Spending Quality indicators against the EQI.

DIMENSIONS OF THE REGIONAL PUBLIC SPENDING QUALITY INDEX

We build on the above theory of institutional quality, focusing on policy implementation, and adapt it to the specific context of government contracting. Moreover, a prior systematic review of adequate indicators and dimensions of government quality (Fazekas, 2017) also informed our theoretical and empirical set-up. Hence, we propose four main dimensions or pillars for Public Spending Quality index:

- Transparency,
- Competition,
- Administrative efficiency, and
- Corruption control.

While these dimensions are often intertwined with each other in academic and policy discussions, they are discussed and measured separately.

The principle of **transparency** implies that information about public procurement should be readily available in a precise, reliable, and structured form for the public as a whole or its representatives (Kovacic et al., 2006; OECD, 2007; Soreide, 2002). Transparency should concern all the information pertaining to public procurement processes and outcomes such as general laws, regulations, judicial decisions, administrative rulings, procedures and policies on public procurement, statistics on procurement activities, and individual procedures and award decisions. While excess transparency may harm competition in some cases (e.g. disclosure of commercially sensitive information), generally more transparency in European public procurement is deemed desirable (Bauhr et al., 2019). While transparency of course has a broader meaning, here it is narrowly defined as compliance with the already extensive information disclosure requirements in EU Public Procurement Directives.

The principle of **competition** implies that the beneficial effects of multiple bidders competing against each other are harnessed to achieve low prices, high quality and on-time delivery of procured goods, works, and services (Cingolani & Fazekas, 2017; Lewis-Faupel et al., 2016; OECD/Sigma, 2014). Such beneficial effects arise when competition is intense, open, and fair, such that potential bidders have equal opportunities for participation (Arrowsmith, 2009). Fair competition implies a level playing field for every potential and actual competitor. In general, decision-making procedures should be rule-bound whereby every rule is easily accessible to potential and actual bidders. Naturally, bidders may be treated differently if a reasonable justification for such treatment is specified prior to the procedure.

The principle of **administrative efficiency** is best understood as minimizing the total cost of achieving the pre-determined outcome of public procurement, i.e. the successful completion of the contract. This implies that the adequateness of project design and the cost-benefit ratio of alternative designs are not taken into account in this dimension. This vastly simplifies the analysis and allows for comparisons to be made between highly divergent markets and organisations in addition to very much aligning the conceptualization with the academic literature on impartiality in policy implementation rather than decision making (Rothstein & Teorell, 2008).

While defining **corruption** would merit a long discussion on its own, within the framework we adopted for public procurement, it is a more straightforward exercise. This framework allows us to concentrate on high-level corruption typically perpetrated by political and economic elites in order to favour connected companies over others, hence, breaking the principles of equal access and ethical universalism (Mungiu-Pippidi, 2015; North et al., 2009; World Bank, 2009). By implication, corruption in public procurement is defined as the allocation and performance of government contracts by bending prior explicit rules and principles of open and fair public procurement in order to benefit a closed network while denying access to all others (Fazekas et al., 2016). Corruption control therefore captures the lack of favouring connected bidders. While the above definition of competition partially overlaps with the definition of corruption, the former is decisively broader: corruption is necessarily accompanied by the violation of open and fair competition, but this violation can also take place without corruption, for example when companies collude or buyers are incompetent.

VALIDATION: CORRELATESES AND EFFECTS OF REGIONAL PUBLIC SPENDING QUALITY

Any valid new indicator of regional government quality has to, at least partially, conform to established indicators measuring the same concept on the one hand and to already established theories of institutional quality on the other (Adcock & Collier, 2001). In order to test convergent validity, we look at the association between the newly introduced regional Public Spending Quality indicators and other measures of regional quality of government. Moreover, to demonstrate the construct validity of our new indicators, we use them to test well-established theories, that is theories which we can safely expect to be largely true. By implication, we look at three sets of associations and impacts of government quality: i) the level of economic development, ii) generalized social trust, and iii) survey-based measures of regional institutional quality (Charron et al., 2014).

First, as extensively noted in prior scholarship, the level of development, in terms of GDP per capita for example, is expected to strongly correlate with the quality of institutions (North, 1990). While the direction of causality is subject to intense scholarly debate which we cannot settle within the limitations of this article, we wish to contribute by confirming the positive relationship and highlighting the potential for using long time series of objective indicators on both the dependent and independent sides of the equation.

H1: Higher regional Public Spending Quality is associated with a higher level of development.

Second, in regions where the quality of government is higher, we expect generalized social trust, i.e. trust in strangers or people who do not belong to 'your group', to be higher. This is because where public institutions implement policies impartially and treat citizens equally, people tend to think of each other as law-abiding citizens, making them more likely to trust each other (Rothstein, 2003; Uslaner, 2005).

H2: Higher regional Public Spending Quality is associated with higher generalized social trust.

Third, we expect Public Spending Quality to be positively associated with the broader quality of government in the region because of the existence of virtuous circles (Mungiu-Pippidi, 2015): on the one hand, a highly motivated, highly skilled civil service is better placed to administer public tenders in line with the rules pursuing public goals such as competitive bidding and ensuring low prices (Charron et al., 2017); while on the other hand, impartial decisions and processes in public spending contribute to high quality public services in general; and it also attracts public good-oriented and highly skilled bureaucrats strengthening governments more broadly (Charron et al., 2016).

H3: Higher regional Public Spending Quality is associated with higher quality of government more broadly.

DATA

The analysis makes use of administrative data on public procurement tenders of all EU member states. This data is being increasingly used by scholars to investigate a diverse set of themes such as corruption (Fazekas & Kocsis, 2020), government efficiency (Cingolani & Fazekas, 2020), electoral accountability (Broms et al., 2019), or collusion among companies (Decarolis, 2014). International organisations such as the OECD or the WTO also uses it for monitoring government spending activities (OECD, 2011). Our data collection, cleaning, and analysis have benefitted from this growing literature.

The database contains information on individual public procurement tenders that are regulated administrative procedures in which public bodies purchase goods, works, and services. It derives from the EU's Tenders Electronic Daily (http://ted.europa.eu/) (TED henceforth), which is the mandatory online publication portal for tenders that fall under the remit of the EU Public Procurement Directives. This means that contracts awarded by national and EU bodies are included in the database as well as contracts which are funded by various national and international actors, including EU Structural and Cohesion Funds. A key criterion for publication is contract value: if it exceeds uniformly set publication thresholds (which have changed only marginally over time), the contract has to follow procedural rules set out in the Directives and be published on TED, hence be present in the database. Publication thresholds vary somewhat over time, with the value threshold above which service contracts have to be published being around 130,000 EUR in the last ten years and 5,000,000 EUR for public works contracts[3].

For the analysis, we use the TED database for years 2006-2015 in the EU28. This data represents a complete database of all public procurement procedures conducted under the Directives in the EU28. As all countries' public procurement legislation is within the framework of the Directives, national TED datasets are directly comparable with each other. While below-threshold national data are collected by the EU-funded DIGIWHIST project, these datasets are generally not comparable due to varying national publication thresholds, procedural requirements, and reporting content (Cingolani et al., 2015).

Data in TED is entered into standard reporting forms by procuring bodies, following a common EU reporting guide. The received data is checked by the EU's Publications Office. In spite of this, there is a non-negligible amount of missing or nonsensical data; our analysis shows that data errors tend to be concentrated in selected countries and procuring bodies (more on data quality and improvements below). The complete contract-level public procurement database used as a basis for this analysis can be downloaded at http://digiwhist.eu/resources/data/. The full regional indicators and composite scores are accessible at: http://www.govtransparency.eu/index.php/2021/03/02/regional-public-

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[3] http://europam.eu/?module=country-profile&country=European%20Commission#info_PP

[spending-quality-index-eu](#). The key regional indicators are also part of the QoG EU Regional Dataset of the University of Gothenburg, accessible at: https://www.gu.se/en/quality-government/qog-data/data-downloads/eu-regional-dataset.

TED contains variables appearing in 1) calls for tenders, such as product specification, the deadline for submitting bids, or assessment criteria, and 2) contract award notices, such as name of the winner, awarded contract value, or date of contract signature. For every observed tender, the database contains information from the contract award announcement as publication is always mandatory, while information from call for tenders may not be published under specific circumstances. Missing rates also vary greatly by variable, with some variables like contracting body name not missing at all, while others such as contract value missing extensively.

The TED 2006-2015 database contains more than 4.2 million contracts. Of these, 1.2 million are used in the analysis due to the following exclusions: 1) only local/regional contracting authorities' contracts are analysed excluding central government authorities to capture regional rather than national government performance and decisions; 2) contracts below the mandatory reporting thresholds are excluded in order to maximize the comparability of data across regions[4]; and 3) contracts where the NUTS3 code couldn't be linked to the buyer were excluded (i.e. we could not reliably assign the observation to any region) in order to remove any potential data error. For the regional analysis, three aggregated databases were created to capture public procurement characteristics in the cross section of NUTS2[5] or NUTS3 regions[6] as well as annually for NUTS2 regions using simple aggregation of tender-level variables (averages and sums). The details of arriving at the final analysis database and a full-data quality assessment can be found in Appendix A.

MEASUREMENT MODEL AND INDICATORS

MEASURING QUALITY OF PUBLIC SPENDING OBJECTIVELY

Before discussing indicators and the corresponding literature in depth, we set out basic standards all the selected indicators have to fulfil so that they can support hypothesis testing and policy assessment:

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

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

- **micro-level:** indicators are defined on the level of transactions between buyers and suppliers (i.e. contracts). They can nevertheless be aggregated at higher levels such as regions;

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[4] There is one exception to this condition: below threshold contracts are used for calculating one transparency indicator: voluntary publishing which compares the number of above and below threshold contracts on TED (Table 1).

[5] This sample is only used when external indicators measured on the NUTS2 level such as EQI need to be linked to our dataset.

[6] Many NUTS3 regions are rather small having only a few contracts awarded per year so the annual time series aggregation on NUTS3 level would have produced a less reliable sample.

- **internationally comparable:** while defined on the micro-level, indicators are comparable across countries and regions, due the same underlying theoretical concepts and measurement approach;

- **comprehensive:** indicators adequately capture public procurement performance in a wide set of organisations performing a wide variety of tasks; and

- **time-series:** indicators can be measured and compared over time for at least five years.

Public procurement performance indicators satisfying these criteria are expected to comprehensively and reliably characterise quality of government across EU regions following our conceptual framework (section 2.1). Given data availability constraints, the final indicator set consists of 2-6 individual indicators for each component of the Public Spending Quality index. The selection of indicators had to balance diverse expectations: on the one hand, conceptual fit with the definition of government quality was paramount; on the other hand, data availability and quality in TED posed constraints on measurement. We selected a comprehensive set of indicators which captures quality of public spending from multiple angles, providing a robust and rich assessment of government performance. The diversity of indicators brought together also bring the benefit of triangulating results from different angles. Arguably this meant that our indicators capture both those administrative decisions which we know matter for results (inputs), but also those outputs of government activities which are desirable for citizens (outputs).[7]

Our measurement capturing public procurement implementation decisions and outcomes rests on a number of assumptions which may not fully hold in all contexts. Crucially, what gets to be procured or outsourced is a policy decision which we can only partially measure as we observe procured products, but not procurable products. However, countries and regions may differ in their propensity to outsource, for example, influenced by public management ideas such as New Public Management or under budgetary pressures. As we do not standardize the purchasing baskets of regional governments, rather take all their purchases as a basis for comparisons, such policy choices may weaken the comparability of our indicators as general spending quality indicators. Nevertheless, this assumption of comparable spending structure and policy goals is based on the shared regulatory framework EU Public Procurement Directives which have to be followed by every local government. These Directives stipulate the goals of transparency, competition, efficiency and integrity, our measurement pillars while they also set a standard scope for publication hence our dataset. Moreover, the bulk of public procurement spending constitutes purchases which are uniformly treated across Europe irrespective of public sector philosophy. For example, construction works and infrastructure development are barely ever done in-house by governments and they constitute about half of our data.

The indicator selection, definition, and grouping were based on a prior comprehensive review of the literature as well as in-depth discussions with expert policy makers and academics potentially using such indicators at the European Commission's DG REGIO (Fazekas, 2017).[8] Given the rich prior literature using data and indicators similar to ours, we could predominantly rely on trusted evidence for placing individual indicators under the different pillars. This carries the benefits of making use of

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[7] Data users who wish to explore the relationships between our input and output indicators such as transparency and corruption, we recommend taking the individual indicators rather than the composite scores.

[8] A broader set of theoretically relevant and empirically feasible indicators has been tested than what is reported here. Those indicators which did not pass basic statistical tests, indicating whether there is sufficient variance for discriminating European regions, were excluded from the present discussion. For full details, see Fazekas (2017).

tried measurement concepts as well as interpretation for each indicator, while also contributing to cumulative knowledge generation in the field.

Below, each pillar and the corresponding indicators are discussed in detail. While the discussion takes note of the contract-level definition of each indicator and the conceptual logic behind it, the final indicator list is already expressed in aggregate regional terms (Table 1). For descriptive statistics of each indicator see Appendix B, Table B1.

TABLE 1. LIST OF PUBLIC SPENDING QUALITY INDICATORS, NUTS REGIONS, TED, 2006-2015

VARIABLE GROUP	VARIABLE NAME	INDICATOR DEFINITION: REGION LEVEL
TRANSPARENCY	contract notice publication	% call for tenders published compared to all awarded contracts
	use of open procedures	% contracts awarded in an open or restricted procedure type over all contract awards
	reporting completeness	% non-missing information of all mandatory information fields[9]
	voluntary reporting	% below EU threshold[10] contract awards over all contract awards
COMPETITION	intensity of competition	Average number of bids submitted (trimmed mean[11])
	non-local suppliers	% contract awards to firms headquartered in a different region than the contracting body over all contract awards
ADMINISTRATIVE EFFICIENCY	decision making speed	% deviation of average decision making length from market average[12] (higher values indicate shorter than average)
	MEAT assessment criteria	% tenders using MEAT assessment criteria compared to market average[13]
	price savings	% deviation of contract value from estimated contract value (higher values indicate higher savings)
CONTROL OF CORRUPTION RISKS[14]	single bidding	% contract awards with more than one bid submitted over all contract awards (competitive markets only)
	call for tenders publication	% of contract awards with call for tender published in the official journal
	procedure type	% of contract awards conducted in open procedure types
	length of advertisement period	% of contract awards with long enough advertisement for competitors preparing bids
	evaluation criteria	% of contract awards without unusually high weights of non-quantitative evaluation criteria
	length of decision period	% of contract awards without unusually few days between submission deadline and announcing contract award

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[9] Nineteen information fields were considered for information reporting completeness: contracting body name, contracting body address, contracting body settlement name, contracting body postcode, winner name, winner address, winner settlement name, winner postcode, winner country, procedure type, main CPV code, NUTS code, use of EU Funds, type of assessment criteria used, contract award date, number of bids, contract value, and use of subcontracting. In each case, missing values were marked as incomplete information as incorrect or meaningless information provision could not be assessed unfortunately.

[10] For current EU contract value thresholds see: http://ec.europa.eu/growth/single-market/public-procurement/rules-implementation/thresholds/index_en.htm

[11] Bidder number values above 20 are recoded as 20.

[12] The market average decision making length is defined as the arithmetic average by market measured in days (defined by 2-digit CPV codes).

[13] Average MEAT criteria use by market is defined by calculating the percentage of contracts using MEAT criteria within any CPV division (using 2-digit length code).

[14] In order to make this component of composite score comparable to the others its direction has been rescaled, that is higher values mean better performance which is lower corruption risks. Corruption proxies are only defined on competitive markets.

Transparency indicators aim to capture different aspects of public procurement information availability within TED which have been shown to influence bidding outcomes and organisational behaviour (Bauhr et al., 2019; Tóth & Fazekas, 2017). First, publishing the call for tenders notice on TED assures that a wider pool of bidders can access timely information on a bidding opportunity, as opposed to publishing only via national public procurement portals or newspapers (Table 1). Second, open tenders are those which allow for any company to bid, as long as the minimal conditions are fulfilled. Open tenders also require the broadest possible advertisement reach, increasing the scope of transparency. Third, the reporting completeness indicator goes beyond the mere presence of different announcements and their dissemination by looking into the mandatory fields within standard tendering announcements and whether they are actually filled in. In the absence of complete data fields, the actual level of transparency which matters for bidding firms when preparing their bids is low. Fourth, voluntary reporting on TED takes public procurement transparency one step further in as much as even those tenders are placed on the TED portal following its stringent publication standards which are below minimum contract value thresholds. Such publication practice signals additional effort by public buyers to go beyond the legal minimum and encourage open competition[15].

Indicators of **competition** aim to capture both the intensity of competition and the composition of participating bidders (Tóth & Fazekas, 2017). First, intensity of competition measured by the number of bids submitted captures a simple idea that more bidders make for a stronger, healthier competitive environment, with the benefits of each additional bidder diminishing as there are more and more bidders on the market. Second, the share of non-local bidders indicator aims to signal that when at least some bidders come from outside the immediate locality of the buyer, competition is expected to be more intense due to more diverse companies competing (Coviello & Gagliarducci, 2017).

Indicators of **administrative efficiency** aim to capture both the processes and outcomes of how public buyers minimize the total cost of achieving a pre-determined outcome of public procurement tenders (Cingolani & Fazekas, 2017). First, decision-making speed approximates the cost of evaluating tenders and responding to legal challenges, operating under the assumption that slower decision making means higher costs for both public and private actors. Second, the use of most economically advantageous tender (MEAT) criteria implies that considerations other than price are taken into account. As quality is often complex to assess while certainly a very important parameter besides price, the use of MEAT criteria carries the potential for better value-for-money outcomes through a more balanced assessment of bids. Third, price savings complements the previous indicator on quality considerations in that it captures the size of discounts companies offer compared to reference prices; that is, the cheaper the winning bid, the better the process.

Indicators of **corruption control** aim to capture the extent to which a given situation lowers the risk of government contracts being allocated in a way that benefits a closed network while denying access to all others; this scenario occurs through the subversion and violation of established explicit rules and the principles of open and fair public procurement (Fazekas et al., 2016). First, the simplest indication that the principles of open and fair competition are being violated is when only one bid is submitted for a tender in a competitive market, meaning there are companies which could have bid, yet only one company did so (Klasnja, 2016).[16] In order to construct a more comprehensive indicator of corruption risk, additional risk factors were also considered which pertain to tendering processes hence signal

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[15] This interpretation rests on the assumption that there is a large number of contracts below the EU reporting thresholds for which there is a choice of voluntarily publishing them or not. Give observed contract distributions on TED as well as national datasets collected by DIGIWHIST, this assumption appears to be fulfilled.

[16] While single bidding is also related to competition, the complete lack of competitors is better characterised as a corruption risk due to the likely involvement of deliberate restriction of the bidder pool.

potentially deliberate modifications by public bodies (Fazekas & Kocsis, 2020). Second, 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 non-connected competitors to prepare bids.[17] This is only relevant in non-open procedures where publication is voluntary (please note the difference between this indicator which only applies to non-open procedures as defined by the next corruption risk indicator and the contract notice publication indicator in the transparency pilar which is calculated over all tenders). Third, while open competition is relatively hard to avoid in some procedure types such as open tender, others such as negotiated tenders are by default less competitive; hence using less open and transparent procedure types can indicate the deliberate limitation of competition (please note that the exact list of risky procedure types depends on their association with single bidding and varies country by country, making it distinct from the open tendering indicator of the transparency pillar (Fazekas & Kocsis, 2020)). Fourth, a too short advertisement period (number of days between publishing a tender and submission deadline), can inhibit non-connected bidders in preparing adequate bids while the buyer informally informs the favoured bidder about the opportunity ahead of time. Alternatively, the advertisement period becomes lengthy due to legal challenge which may also signal corruption risks. Fifth, subjective, hard-to-quantify evaluation criteria (e.g. quality of company organigram) rather than quantitative or price-related criteria allows rigged assessment procedures as they create room for discretion and limit accountability mechanisms. Alternatively, price-only criteria can also be abused for corrupt ends when the connected firm bids with the lowest price knowing that quality will not be monitored. Sixth, if the time used to decide on the submitted bids is excessively short or lengthy, it can signal corruption risks. Snap decisions may reflect premediated assessment, while a long decision period and the corresponding legal challenge suggests outright violation of laws. A full description of these corruption red flags can be found in Fazekas & Kocsis (2017).

Placing individual indicators in the 4 different pillars was based on prior literature to allow us to contribute to ongoing knowledge accumulation and to rely on the rich evidence-base in this field. Nevertheless, there are some links and partial overlaps between individual indicators which need further clarification to strengthen the analytical value of the composite scores. These overlaps arise in relation to the corruption risk indicators vis a vis transparency and competition indicators. This is natural as both transparency and openness of competition are strong predictors of corruption. We measure corruption as a deviation from the open and competitive norm for allocating public contracts which means that some of our indicators capture the extreme ends of the underlying distributions for transparency or competition. For example, single bidding, that is 1 bid submitted, is a corruption risk indicator while the average number of bidders is a competition indicator. Both indicators are widely used in the literature for measuring corruption risks and competition respectively as they capture different features of the underlying bidder number distribution, lower end of the distribution and the average respectively. Similarly, the non-publication of call for tenders in specific and carefully selected procedure types is interpreted as signalling likely corrupt intent as underpinned by both qualitative and quantitative evidence (Fazekas et al., 2016). While the publication of call for tenders across all tenders and procedure types represents a straightforward measure of transparency across the board. Supporting our argument that these indicators measure different concepts, it is shown that the corruption pillar has only weak correlation with the transparency or competition pillars (Table B2 in Appendix B).

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[17] While not publishing relates to transparency too, our preferred interpretation as a corruption risk indicator is due to the fact that it is typically used as a tool to avoid non-connected companies bidding.

COMPOSITE PUBLIC SPENDING QUALITY INDEX AND ITS FEATURES

We implemented a theory-driven aggregation of the above individual indicators. We construct composite scores for each pillar as well as for the composite Public Spending Quality index. After standardizing each indicator, we carried out a simple averaging across indicators first within each pillar then across pillars.[18] In addition to being parsimonious, this method reflects our theoretical expectations closest, that is it combines indicators as our theory predicts.

We produced regional scores for the cross-section of NUTS2 and NUTS3 regions over the whole 2006-2015 period as well as for NUTS2 regions annually following the same procedures described here. First, we assigned contracts to regions based on the buyer's main address in order to reflect the procurement decisions made by public organisations. Given that we only consider local and regional public buyers such as municipalities, the location of contract performance is also typically the same region as the buyer's region. We assigned contracts to years based on the contract award year because this is the point in time when most of our indicators are defined and the corresponding government decisions made such as evaluating bidders.[19] Second, we imposed a minimum number of contracts per region or region-year to assure that the underlying contracting data is of sufficient scope for regional scoring (35 for NUTS3 regions and 100 for NUTS2 regions). Third, we standardized indicators by transforming them into a 0-100 band with 100 representing the best observed performance over the whole period and 0 representing the worst (this is essentially a frontier benchmarking approach such as the methodology adopted by the Doing Business scoring (World Bank, 2016). Fourth, we calculated the simple arithmetic average of indicators constituting each pillar. In the rare occasions that one of the constitutive variables were missing on the regional level, we averaged only the observed indicators. Fifth, we averaged across the four pillars giving equal weight to each of them producing the composite Public Spending Quality index. Averaging across the pillars in a separate step assures that the number of composing indicators within each pillar does not influence the pillar's importance or weight in the total Public Spending Quality index.

The composite regional Public Spending Quality index follows a roughly normal distribution, warranting later statistical analysis while the four pillars themselves are roughly normally distributed, too (see Appendix B for further descriptive statistics, in particular Figure B1 and B2 for the distributions of the composite score and the four pillars). Each of the four pillars are positively correlated with the total Public Spending Quality index with the transparency component displaying the weakest relationship as quite a few well governed regions perform poorly on this dimension as noted by the European Commission a long time ago[20] (for details see Appendix B). In addition, the pillars are weakly correlated with each other too (Table B2).

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[18] In addition, we also carried out a Principal Component Analysis (PCA) which leads to similar results in as much as individual indicators are positively associated with the main components. Nevertheless, PCA delivers somewhat different split of the four main pillars by combining corruption risks with some competition indices and keep others separate (for full results see Appendix C). Our preference for the simpler, theory-driven aggregation method is further underpinned by its superior performance on validity tests as shown below.

[19] In a small fraction of observations, we have the call for tenders published at the end of the year and contract award taking place at the beginning of the year which could bias year-to-year comparisons. We consider this as a small problem because there are only few new call for tenders announced in mid/end of December.

[20]

http://ec.europa.eu/internal_market/scoreboard/performance_per_policy_area/public_procurement/index_e n.htm

The distributions of the four pillars and the overall composite score show some interesting differences. While the average Public Spending Quality index is in the 50 to 60 range, not all of the components reflect this distribution; in particular, the average of the competition score is about 30 points while the transparency and efficiency score averages are all somewhere around 60. These differences in average scores as well as further differences in the observed minimum and maximum values in each score are driven by the dispersion of the underlying indicators among regions. In other words, the average competition score is very low because the average region's performance is vastly inferior compared to the frontrunner region in terms of bidder number and share of non-local suppliers. Hence, each composite indicator is best used in comparative terms with regards to the top performing European region along each dimension, while the underlying individual indicators can be used to understand absolute differences among regions and also to set performance targets directly amenable to policy interventions.

Following up on previous regional scholarship, we can further confirm that regional quality of government differences matter (Charron et al., 2014): the regional Public Spending Quality indicators display a wide within-country variation[21] (Figure B3), even larger than the variance revealed by the three EQI measurements (2010, 2013, and 2017). Within-country variation is particularly pronounced in large federal countries like Italy, Germany, and Spain, while there is a surprisingly strong variation within smaller countries like Greece, Bulgaria and Portugal, too. Top performing countries like Denmark, Sweden, and Finland are much more diverse within their national boundaries than revealed by the EQI. Some countries score markedly differently compared to what other indicators like EQI reveal. For example, Finland scores close to the EU average rather than the top or Estonia is below EU average. The latter low performance is largely due to a particularly weak competition performance (i.e. low number of bidders) but also below EU average score on efficiency and control of corruption. Given that EQI focuses on low-level bribery while the Public Spending Quality indicators look at high value contracts and hence high-level policy decisions, the discrepancy is both interesting and plausible[22]. The Public Spending Quality indicators derived from administrative data don't suffer from stickiness of perceptions, hence reveal a larger variation over time than survey-based measures (please note that regions remain largely consistent over time, with 69% of total time series variance on the NUTS2 level explained by regions, the trajectories of the most and least volatile regions can be found in Figures B10 and B11, respectively). Worryingly, the Public Spending Quality index shows a steady decline across the EU, in particular in old EU member states (Figure B4).

A powerful feature of our large-scale administrative dataset is that the quality of public spending can be analysed at an exceptionally granular level such as NUTS3 regions (Figure 1) or even at the municipal level (Bromes et al, 2019). This nuanced disaggregation of the Public Spending Quality score yet again reveals considerable within-country variation as well as regional similarities across national borders such as parts of Northern Austria, Southern Czech Republic and Western Slovakia.

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[21] Interestingly, there is no statistically significant difference between capital and non-capital regions on the NUTS2-level Public Spending Quality index suggesting that there is no inherent bias against rural regions in the index.

[22] Some accounts of political or high-level corruption in Estonia report persistent problems in spite of successful reforms in eliminating low-level or ordinary corruption. For example: https://www.baltictimes.com/report__political_corruption_exists_in_estonia/
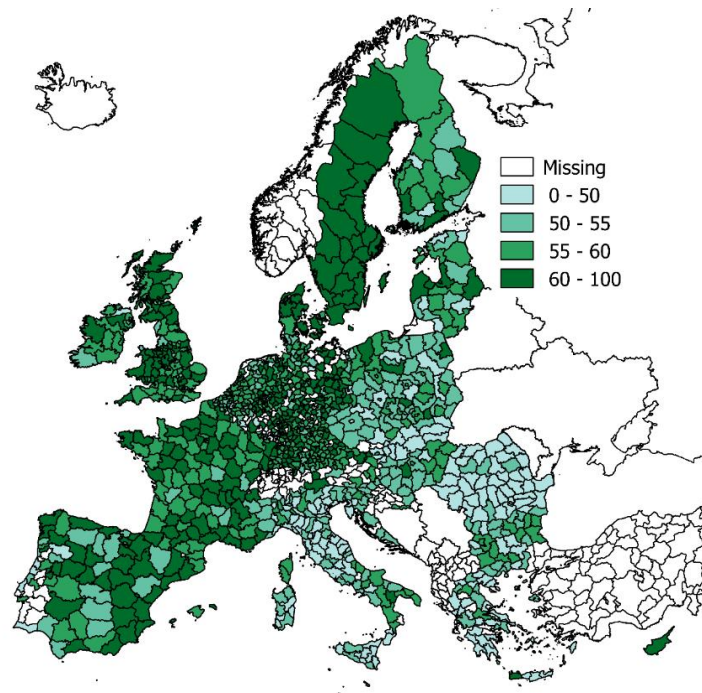
Note: Interactive map accessible at
https://public.tableau.com/profile/mihaly.fazekas#!/vizhome/regiopp/nuts2 .

INDICATOR VALIDITY

We test the hypotheses both in a simple bivariate setting and using regression analysis. The tests for H2 and H3 are carried out on a cross-sectional NUTS2-level sample due to the lack of time series data as well as more detailed geographic disaggregation on the outcomes. The tests for H1 are carried out both in a cross-sectional NUTS2 setting to preserve comparability with the other tests and also in an annual time-series NUTS2 set-up in order to capitalize on the temporal variance of GDP data.

Regarding H1, on the association between regional quality of public spending and the level of development, we find supportive evidence both in cross-sectional and time-series set-ups. The Public Spending Quality score is moderately correlated with the average log GDP/capita (PPS) on NUTS2 level (Figure B5 and Table B2 in Appendix B). However, this simple bivariate relationship is likely to be driven by confounding factors such as country characteristics or temporal shocks (recall, the global financial crisis unfolded at the middle of our time series).

In order to address concerns regarding confounding factors, even though a comprehensive causal analysis is beyond the scope of this article, we carry out regression analysis accounting for major confounders (Table 2). In a cross-sectional OLS regression set-up, Public Spending Quality is associated with a 0.006-0.019 increase in log GDP per capita controlling for country log GDP per capita (PPS), region size, population and whether the region is a capital region. For example, in model 2 in Table 2, GDP per capita (PPS) is by about 1000 EUR higher when the Public Spending Quality score increases from the EU average (56) by 1 standard deviation (6.5). The estimated effects remain positive and significant in a country-level fixed effects panel data set-up (Hausman tests suggest that the fixed effects specification is preferable), albeit effect sizes decrease somewhat: 0.001-0.002. In the most

complete model, including lagged Public Spending Quality scores, an increase from the EU average (58) by 1 standard deviation (5.5) increases GDP per capita (PPS) by about 300 EUR or a GDP increase of about 1.2%. The fixed effects panel regression models with lagged Public Spending Quality scores (1 and 2 year lags) are our preferred specifications because they not only account for country-level time-invariant characteristics, but also for annual economic shocks. In addition, the lagged values of Public Spending Quality, while largely insignificant, account for the historical process whereby past government quality contributes to the more recent values of economic development.

TABLE 2. REGRESSION RESULTS ON THE PUBLIC SPENDING QUALITY INDEX AND LOG GDP PER CAPITA RELATIONSHIP (H1), NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS

model nr.	(1)	(2)	(3)	(4)	(5)
model type	cross-sectional			FE panel	
DV	log GDP per capita				
Public Spending Quality score	0.0185***	0.00582**	0.000763+	0.00179***	0.00151***
	(0.000)	(0.007)	(0.087)	(0.000)	(0.000)
L. Public Spending Quality score				-0.000139	0.000697
				(0.740)	(0.102)
L2. Public Spending Quality score					-0.000117
					(0.771)
country development (log GDP per capita, PPS)		0.990***			
		(0.000)			
population (log nr. of inhabitants)	0.0620*	0.0492**			
	(0.031)	(0.010)			
region area (log sq km)	-0.098***	-0.044***			
	(0.000)	(0.000)			
capital region (Y/N)	0.290***	0.368***			
	(0.000)	(0.000)			
year of contract award=2006			baseline		
year of contract award=2007			0.0465***	baseline	
			(0.000)		
year of contract award=2008			0.0490***	-0.00577	baseline
			(0.000)	(0.253)	
year of contract award=2009			-0.0125*	-0.0680***	-0.0658***
			(0.038)	(0.000)	(0.000)
year of contract award=2010			0.0254***	-0.0293***	-0.0280***
			(0.000)	(0.000)	(0.000)
year of contract award=2011			0.0540***	-0.000491	0.00148
			(0.000)	(0.922)	(0.737)
year of contract award=2012			0.0744***	0.0203***	0.0225***
			(0.000)	(0.000)	(0.000)
year of contract award=2013			0.0820***	0.0273***	0.0285***
			(0.000)	(0.000)	(0.000)
year of contract award=2014			0.110***	0.0554***	0.0565***
			(0.000)	(0.000)	(0.000)
Constant	9.036***	-0.706	9.992***	9.996***	9.968***
	(0.000)	(0.244)	(0.000)	(0.000)	(0.000)
Observations	252	252	1797	1640	1444
R-squared	0.287	0.689	0.010	0.110	0.110

p-values in parentheses
*+ p<0.1; * p<0.05; ** p<0.01; *** p<0.001*

Regarding H2, linking regional quality of public spending to generalised social trust, we carry out cross-sectional analysis and find moderately strong supportive evidence. In a simple, bivariate set-up, Public Spending Quality and trust are significantly and moderately strongly positively correlated (Table B2 in Appendix B). In regressions with country clustered standard errors, controlling for the country's level of development, the regions' size and population, and whether it is a capital region, trust increases by about 0.01 points for each point increase in Public Spending Quality (Table 3). One standard deviation increase in Public Spending Quality (6.5) is associated with a change in trust by 0.043 which is about the difference in trust levels between Italy and Germany. However, the effect becomes insignificant with the inclusion of country development which may signal that the broader country-level context may mediate the quality of government-trust relationship.

TABLE 3. REGRESSION RESULTS ON THE ASSOCIATION BETWEEN PUBLIC SPENDING QUALITY AND SOCIAL TRUST (H2) AS WELL AS BROADER QUALITY OF GOVERNMENT (H3), NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS

model nr.	(1)	(2)	(3)	(4)	(5)	(6)
DV	avg.social trust		EQI		avg.pub.sec. meritocracy	
Public Spending Quality score	0.00948+	0.00664	0.0778**	0.0573**	0.0600***	0.0498***
	(0.10)	(0.281)	(0.002)	(0.002)	(0.000)	(0.000)
country development (log GDP per capita, PPS)		0.222+		1.843***		0.800*
		(0.057)		(0.000)		(0.011)
population (log nr of inhabitants)	-0.00703	-0.00897	-0.169	-0.216*	0.0746	0.0676
	(0.799)	(0.707)	(0.314)	(0.045)	(0.242)	(0.142)
region area (log sq km)	-0.0236	-0.00890	-0.234	-0.0402	-0.124*	-0.0710
	(0.421)	(0.788)	(0.266)	(0.712)	(0.020)	(0.261)
capital region (Y/N)	-0.0428	-0.0248	-0.254	-0.0990	-0.518**	-0.453*
	(0.508)	(0.711)	(0.550)	(0.695)	(0.005)	(0.021)
Constant	0.251	-1.969+	0.449	-18.36***	0.933	-7.071*
	(0.590)	(0.094)	(0.799)	(0.000)	(0.363)	(0.014)
Observations	242	242	136	136	242	242
R-squared	0.140	0.213	0.391	0.620	0.413	0.484

p-values in parentheses; standard errors clustered by country
*+ p<0.1; * p<0.05; ** p<0.01; *** p<0.001*

Regarding H3, on the relationship between regional quality of public spending and broader government quality, the cross-sectional analyses are strongly supportive. Given the paucity of reliable regional quality of government indicators, we use two measures coming from the same survey: the European Quality of Government Index (EQI) (Charron et al., 2014) and the regional public sector meritocracy indicator, that is the hiring and promotion of public sector employees based on merit or performance rather than connections (Charron et al., 2016). Both of them measure the quality of government along a somewhat different dimension than public procurement.[23] In addition, they gather the views of ordinary citizens (e.g. experiences with bribery in interacting with police) rather than high value spending decisions captured by public procurement data. While these differences

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[23] Regarding EQI as a broader measure of regional quality of institutions, it is an important caveat that the main focus of EQI is local public services in education, healthcare and police; hence, in a sense, it is narrower.

warrant some discrepancies between the EQI and public service meritocracy vis-a-vis our Public Spending Quality index, correlating them is suitable for testing convergent validity.

In a simple bivariate set-up, both EQI and meritocracy are positively and significantly correlated with the Public Spending Quality score (Figure 2 and Table B2 in Appendix B). The linear correlation coefficients are nearly twice as large as for the two other hypotheses. In regression analyses, the same strong, significant, and positive relationship holds (Table 3). One point increase in the Public Spending Quality score is associated with increased EQI by 0.06-0.08 points and meritocracy by 0.05-0.06 in our regression models. The estimated impacts are substantial, for example a one standard deviation increase in Public Spending Quality (6.5) is associated with an 0.37 increase in EQI which corresponds to the average difference between French and Portuguese regions. Nevertheless, some interesting discrepancies arise between EQI and the Public Spending Quality score warranting further investigation, for example some Spanish regions perform markedly better using public procurement data compared to the survey-based scores. Most notably, Catalonia performs outstandingly in its public procurement while scoring below EU average based on the EQI. Its strong Public Spending Quality performance is due to high scores across all 4 pillars, but in particular in administrative efficiency (e.g. savings achieved and the use of MEAT assessment criteria). This is not surprising given Catalonia is one of the economic powerhouses of Spain and the Public Spending Quality score is strongly correlated with economic performance.

FIGURE 2. SCATTERPLOT OF PUBLIC SPENDING QUALITY AND EQI, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N_REGIONS=274
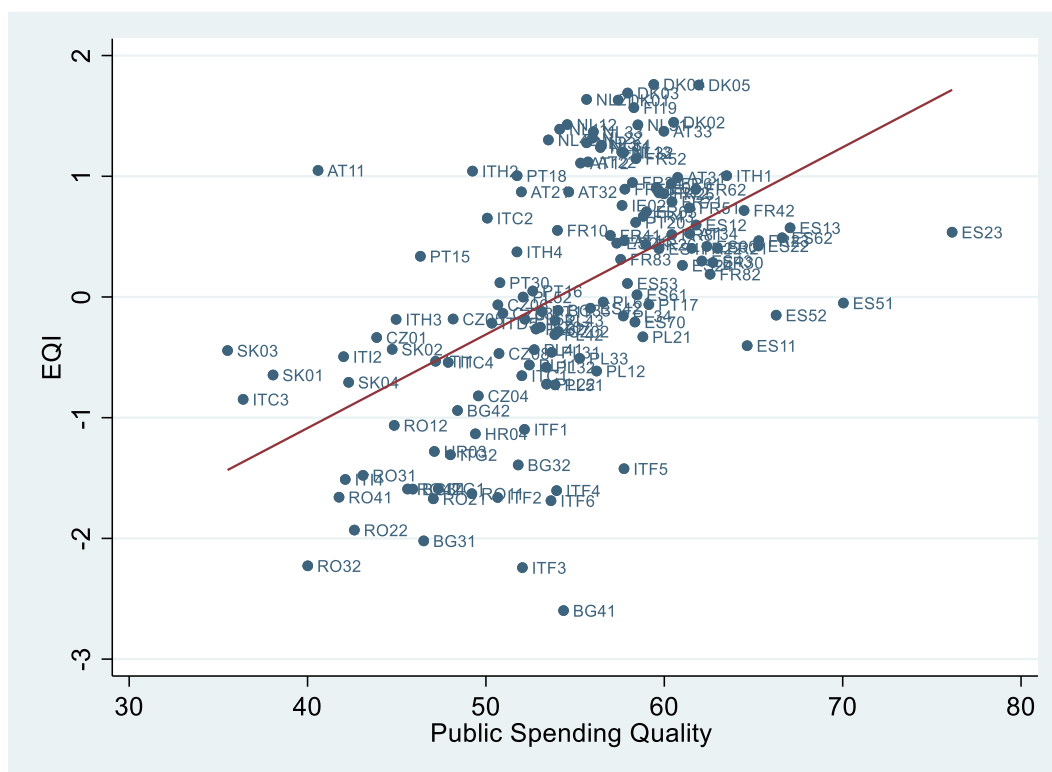
CONCLUSIONS

Reliably and precisely measuring the quality of government has been a challenge for decades on the country level but even more on the regional level, despite the growing evidence of its importance for growth, regional convergence and human well-being. The article addresses this gap by developing the Public Spending Quality index which offers novel, regional measures of government quality using administrative data on over 4 million contracts across the EU. The indicators capture 4 fundamental dimensions of good government in public spending: transparency, competition, administrative efficiency, and corruption control. While it is designed to proxy good government more broadly, it is most closely associated with the quality of public spending and public investment. The authors have made the data available on online dashboards as well as freely downloadable at http://www.govtransparency.eu/index.php/2021/03/02/regional-public-spending-quality-index-eu.

The new Public Spending Quality indicators not only follow the theoretical definition and dimensions of good government, but they also turn out to be of particular value in understanding GDP/capita, social trust and survey-based measures of good government on the regional level such as the EQI. Our analysis reveals that regions with higher Public Spending Quality index have higher GDP/capita: a one standard deviation increase in Public Spending Quality leads to a 300 EUR (PPS) per capita increase in GDP, or 1.2% GDP growth, in a comprehensive fixed effects panel regression model. Increases in trust and EQI associated with Public Spending Quality are similarly substantial and statistically significant.

Nevertheless, these novel indicators are not without their limitations which further research should take into account and if possible improve on. First, we incorporate corruption risks as one pillar, our indicators only indirectly proxy corruption rather than directly measuring it. This is a standard approach in the literature given the clandestine nature of corruption, nevertheless, it brings it potential biases. Second, as some of the indicators are co-determined by the private sector together with government such as number of bidders, the Public Spending Quality index to some degree reflects the strength of the private sector, not only government quality. Hence, in times of severe economic contraction when many private sector companies go bankrupt, the index may partially decline irrespective of government performance. Third, some of the underlying concepts of the 4 pillars are closely linked to each other, such as transparency and corruption control, and overall, they cover a wide conceptual and empirical terrain. Hence, users of the Public Spending Quality index should be careful to avoid endogeneity and whenever it fits their research objectives better they should use the individual pillars. Fourth, while NUTS2 and NUTS3 regions are politically meaningful in many countries, this is not the case for all, introducing a gap between government action and measurement scope. Fifth, we could only empirically measure some aspects of Public Spending Quality with data on project implementation largely missing. As more and better quality data gets published by governments, this limitation could be alleviated.

While this article only took the first steps to develop and demonstrate the usefulness of such novel indicators based on administrative data, we hope to open up new avenues for future research. With more specific and objective indicators of regional government quality which substantially vary over time, it is possible to get a better grasp of regional convergence, and the impact of EU Funds and investment on growth across Europe. Given the increased availability of electronic public procurement records, our approach can also be replicated beyond Europe.

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APPENDICES

APPENDIX A: ADDITIONAL DESCRIPTION OF DATABASE CREATION AND DATA QUALITY

Given the high degree of disaggregation of the data and the nontrivial amount of missing information, we conducted a detailed data quality assessment from the viewpoint of regional quality of government analysis, establishing sample size, availability of key variables, inconsistencies among records, reasons for sample size reduction, and the limitations of the dataset. Main findings are discussed here while a number of additional data tables are included at the end of this appendix.

First, the database was restricted to above-threshold tenders by removing voluntarily published notices, that is, those which fall below the publication thresholds (European Commission, 2016) (Table A1). This was necessary as voluntary publication is not equally prevalent across member states, hence including these low value tenders would distort regional scores. Below-threshold tenders can be identified through a thorough review of the Directives which define contract value, contract type (i.e. supplies, services, and works), exceptional economic sectors such as legal services, and regulatory change-related conditions (e.g. adjusting thresholds for inflation). Due to data quality issues and concerns over the proper application of these complicated rules in a wide range of tenders, we used a simplified method and applied a blanket 125,000 EUR contract value threshold. Such an approach is also used by DG GROW, for example in the Public Procurement Single Market Scorecard[24].

Second, tenders conducted by local bodies were identified by the 'entity type' variable of the TED database (Table ATable A1). The following entity types were considered to be local authorities: 1) regional or local authorities; 2) entities operating in the water, energy, transport and telecom sectors; 3) regional or local agencies/offices. If the entity type information was 'other' or missing, the tender was excluded from the analysis as these categories contain a variety of different organisations, of which only a minority appears to be local or regional. For the smallest member states (MS) - CY, EE, LT, LU, LV, and MT - national bodies were included in the local sample too with the restriction that purchases in markets rarely used by local bodies across the EU were excluded (2-digit CPV divisions with less than 2% of purchases in the local sample).

Third, the regional analysis requires information on the location of contracting authorities (Table A1). Unfortunately, NUTS codes of buyers are usually not published in the TED database, only for contract implementation location, but this does not necessarily overlap with the region of the entity. In addition, the NUTS code of contract implementation is often not detailed enough for regional analysis: NUTS2 or NUTS1 codes instead of NUTS3. In order to create sufficiently detailed geographic data, NUTS3 codes were matched to buyers based on the postcode and settlement name. This information is mostly available in public procurement notices, and Eurostat correspondence tables allow for an almost complete matching to NUTS3 codes.[25] While postcode-NUTS correspondence tables are published only for the years 2010 and 2013, settlement name-NUTS tables are available for every year

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http://ec.europa.eu/internal_market/scoreboard/performance_per_policy_area/public_procurement/index_en.htm

[25] Information on local administrative units: http://ec.europa.eu/eurostat/web/nuts/local-administrative-units
NUTS-postcode correspondence tables: http://ec.europa.eu/eurostat/tercet/flatfiles.do

in 2010-2016. The tables between 2010 and 2012 publish 2010 NUTS codes, while the newer ones have 2013 NUTS codes.

When matching NUTS codes to postcodes and settlement names of contracting authorities, the newest correspondence tables were used: the 2013 postcode-NUTS table and the 2013 settlement name-NUTS table. If there was no match in these tables, the second newest table was used, and so on. In the final database, NUTS 2010 codes were recoded to NUTS 2013 codes using the 2010-2013 NUTS correspondence table on the Eurostat's website describing the history of NUTS. [26] This translation to the latest NUTS nomenclature introduced some bias in the regional coding, as splitting one NUTS region into two cannot be recoded one-to-one, for example.

Before applying the city name-NUTS and postcode-NUTS matching algorithms, string cleaning procedures were carried out to standardize location names as much as possible, for example by removing non-alphabetic characters and lowercasing them and removing terms that are not strictly part of the city name (e.g., terms like "municipality of", "commune of", "Stadt", "Landeshauptstadt"). Additionally, postcodes were checked to ensure they complied with national standards, which included removing alphabetic characters except in cases where these characters are officially part of postcodes (UK, Ireland and Malta). Then, a matching algorithm was applied which conservatively links postcodes and settlement names to NUTS3 codes, that is only perfect matches were accepted (the statistical details of the matching procedure are highlighted in Table A3). Although the success rate of the postcode-based and the settlement name-based methods vary greatly by country, the combination of the two procedures was able to decrease the rate of tenders without NUTS3 code below 1%. (Table A1). Reassuringly, there is very little variation over time in the sample selection and error rates warranting robust time series analysis.

In order to check the reliability of assigning NUTS3 codes to contracts, NUTS3 codes based on the settlement name or settlement postcode were compared (Table A7). Overall, the fit is 96%, but there are some countries with surprisingly low ratios, such as Croatia. A random example points at the potential discrepancy between the EC correspondence tables we used for assigning NUTS3 codes: the Croatian city of Rijeka belongs to HR031 according to settlement name correspondence table,[27] while it belongs to HR032 according to the postcode correspondence table[28]. When the two matching methods deviated, the postcode-based NUTS code was assigned because postcodes are less likely to be mistyped than settlement names. Settlement names often exist in multiple versions and different settlements might have very similar names (e.g. Frankfurt am Main, Frankfurt an der Oder, etc.).

The final sample contains 1,278,177 contract awards (lots) for 2006-2015 in the EU28, all of which are above the threshold, conducted by local authorities, and have a NUTS3 code available (Table A1). This is a considerable decrease of sample size from the starting number; however, it is predominantly due to a local bodies representing a relatively low share of a given country's total procurement spending (across all EU28 countries, an average of 36% of contracts are awarded by local authorities) as well as a relatively low proportion of above-threshold tenders within the total amount of tenders in the database (84% on average across the EU28).

[26] http://ec.europa.eu/eurostat/web/nuts/history
[27] http://ec.europa.eu/eurostat/web/nuts/local-administrative-units (EU-28_LAU_2016.xlsx)
[28] http://ec.europa.eu/eurostat/tercet/flatfiles.do (pc2016_hr_NUTS-2013_v2.3.csv)

	NUMBER OF ALL CONTRACTS	ABOVE THRESHOLD %	LOCAL AUTHORITY %	NUTS3 CODE AVAILABLE %	NUMBER OF CONTRACTS IN FINAL SAMPLE
AT	31958	73	44	100	10307
BE	59346	88	39	100	21081
BG	68451	75	21	100	9827
CY	8817	89	83	100	6546
CZ	69628	78	28	99	14314
DE	294050	73	48	100	98149
DK	44968	95	57	99	24253
EE	15944	79	81	100	9700
ES	199293	93	55	100	102708
FI	59488	90	55	100	29931
FR	1202190	79	37	99	325539
GR	39635	77	34	99	11373
HR	14602	99	12	100	1701
HU	57873	83	33	100	14676
IE	25526	96	27	97	6310
IT	180776	94	55	100	92302
LT	80132	75	91	100	52856
LU	7505	61	86	100	3738
LV	82997	94	90	100	69304
MT	2123	80	74	99	1207
NL	60338	93	50	95	26788
PL	997934	82	14	100	106403
PT	21001	75	24	96	3922
RO	160593	94	16	100	22709
SE	84612	97	63	100	52088
SI	61847	93	10	100	5207
SK	24820	97	14	100	3307
UK	290839	96	52	97	140622
TOTAL	4247286	84	36	99	1266868

Although the size of the final sample seems enormous at first glance, contract numbers per NUTS3 regions vary greatly, which potentially limits the scope of regional analysis (Figure A1). For example, there are 187 NUTS3 regions out of 1349 with fewer than 51 contracts awarded between 2006-2015; in contrast, there are only 3 such NUTS2 regions. When looking at annual time series of NUTS3 regions, the share of regions with too few observations increases further. Hence, it is suggested that time series analysis is either conducted on the annual NUTS2 level or over longer time periods (e.g. 3-5 years) on NUTS3 level.
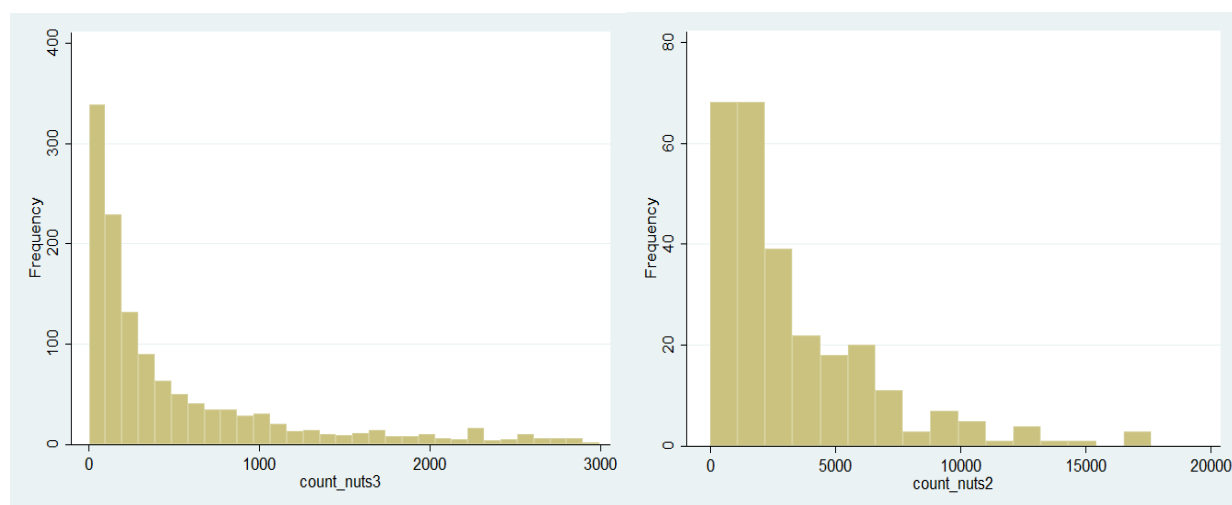
Advancing the discussion on public procurement quality indicators, we briefly discuss here the availability of key variables necessary for calculating these indicators. In the final sample, the quality of key variables varies greatly, potentially biasing some results later on (Table A2). Some variables, such as the procedure type, are available in nearly every announcement; others, such as prices, are only available in about half of the announcements. For more detailed country-level information, see Tables A3 and A4.

TABLE A2. THE AVAILABILITY OF SELECTED VARIABLES USED FOR CALCULATING PERFORMANCE INDICATORS

	NUMBER OF CONTRACTS	% AVAILABLE
CALL FOR TENDER AVAILABLE	867111	68
PROCEDURE TYPE	1255348	99
E-AUCTION	1063542	84
NUMBER OF BIDS	1010727	80
BIDDING DEADLINE	866898	68
SELECTION METHOD	1206490	95
ESTIMATED PRICE	372458	29
FINAL PRICE	937029	74

TABLE A3. THE AVAILABILITY OF VARIABLES NECESSARY FOR CALCULATING RISK INDICATORS BY COUNTRY

	N	call for tender available	procedure type	e-auction	number of bids	bidding deadline	selection method	estimated price	final price
AT	10307	6820	10231	9689	8670	6819	10045	1170	5528
BE	21081	14176	21044	20301	18917	14174	20700	4471	14983
BG	9827	7565	9827	9798	9519	7565	9641	2576	8455
CY	6546	4988	6546	6311	5811	4988	6544	4904	6385
CZ	14314	9084	14259	13807	13433	9084	13907	10161	13571
DE	98149	67136	97162	93437	81607	67122	96081	14831	58844
DK	24253	19197	24229	23276	19018	19197	23530	3133	14391
EE	9700	5803	8753	8983	7589	5803	9695	3182	9688
ES	102708	75045	102505	81632	71101	75045	93042	43614	96375
FI	29931	24415	25848	12595	16993	24415	28103	6715	25259
FR	325539	199857	324822	222873	211506	199820	305651	35393	176929
GR	11373	8396	11100	10673	9532	8396	11064	7815	11182
HR	1701	1608	1701	1700	1699	1608	1701	1694	1701
HU	14676	11079	14545	14435	14250	11065	14640	8917	14394
IE	6310	4083	6285	4299	5479	4083	6286	613	2980
IT	92302	63073	92240	81261	72799	63073	89301	48342	85804
LT	52856	32593	52494	52842	52845	32593	52850	2041	50635
LU	3738	1785	3736	2474	3036	1762	3512	706	2226
LV	69304	51665	66313	68715	69007	51665	69289	29390	67925
MT	1207	964	1206	1053	1187	964	1163	460	1074
NL	26788	17695	26595	25425	23929	17695	26347	2960	8845
PL	106403	83918	106378	99345	102258	83918	104054	81442	103815
PT	3922	2735	3918	3290	2687	2735	3556	1619	3701
RO	22709	15614	22709	22701	22589	15614	22670	14972	22675
SE	52088	38329	52026	41418	42513	38265	39877	4001	11982
SI	5207	3725	5207	4819	4476	3724	5024	3615	4793
SK	3307	2371	3303	2967	3120	2324	3182	2235	3229
UK	140622	93392	140366	123423	115157	93382	135035	31486	109660
Total	1266868	867111	1255348	1063542	1010727	866898	1206490	372458	937029

TABLE A4. THE AVAILABILITY OF VARIABLES NECESSARY FOR CALCULATING RISK INDICATORS BY COUNTRY (%)

	N	call for tender available	procedure type %	e-auction %	number of bids %	bidding deadline %	selection method %	estimated price %	final price %
AT	10307	66	99	94	84	66	97	11	54
BE	21081	67	100	96	90	67	98	21	71
BG	9827	77	100	100	97	77	98	26	86
CY	6546	76	100	96	89	76	100	75	98
CZ	14314	63	100	96	94	63	97	71	95
DE	98149	68	99	95	83	68	98	15	60
DK	24253	79	100	96	78	79	97	13	59
EE	9700	60	90	93	78	60	100	33	100
ES	102708	73	100	79	69	73	91	42	94
FI	29931	82	86	42	57	82	94	22	84
FR	325539	61	100	68	65	61	94	11	54
GR	11373	74	98	94	84	74	97	69	98
HR	1701	95	100	100	100	95	100	100	100
HU	14676	75	99	98	97	75	100	61	98
IE	6310	65	100	68	87	65	100	10	47
IT	92302	68	100	88	79	68	97	52	93
LT	52856	62	99	100	100	62	100	4	96
LU	3738	48	100	66	81	47	94	19	60
LV	69304	75	96	99	100	75	100	42	98
MT	1207	80	100	87	98	80	96	38	89
NL	26788	66	99	95	89	66	98	11	33
PL	106403	79	100	93	96	79	98	77	98
PT	3922	70	100	84	69	70	91	41	94
RO	22709	69	100	100	99	69	100	66	100
SE	52088	74	100	80	82	73	77	8	23
SI	5207	72	100	93	86	72	96	69	92
SK	3307	72	100	90	94	70	96	68	98
UK	140622	66	100	88	82	66	96	22	78
Total	1266868	68	99	84	80	68	95	29	74

TABLE A5. STATISTICS OF THE NUTS3 MATCHING PROCEDURE

	all tenders	availability of postcode %	NUTS3 matched on postcode %	Settlement name availability %	NUTS3 matched on settlement name %	manual correction N	final NUTS3 %
AT	31958	100	78	100	97	6	100
BE	59346	100	99	100	84	48	100
BG	68451	100	45	100	0	37572	100
CY	8817	100	34	100	0	5798	100
CZ	69628	100	38	100	90	2512	99
DE	294050	100	100	100	82	0	100
DK	44968	100	95	100	64	1456	99
EE	15944	99	98	100	83	0	100
ES	199293	99	99	100	91	0	100
FI	59488	98	98	100	85	27	100
FR	1202190	100	97	100	89	3013	99
GR	39635	100	79	100	1	7615	99
HR	14602	100	98	100	47	302	100
HU	57873	100	98	100	96	0	100
IE	25526	34	0	100	11	21865	97
IT	180776	99	95	100	94	1586	100
LT	80132	100	99	100	0	816	100
LU	7505	100	100	100	96	0	100
LV	82997	100	97	100	80	563	100
MT	2123	98	78	100	79	0	99
NL	60338	99	46	100	81	1656	95
PL	997934	100	89	100	82	8145	100
PT	21001	92	79	100	18	2642	96
RO	160593	100	95	100	95	0	100
SE	84612	98	95	100	95	0	100
SI	61847	100	98	100	89	0	100
SK	24820	100	27	100	52	9456	100
UK	290839	99	95	100	14	5056	97
Total	4247286	99	91	100	77	110134	99

TABLE A6. NUMBER OF TENDERS IN THE RAW DATABASE AND THE FINAL SAMPLE BY YEAR

	all tenders N	above threshold %	local authority %	NUTS3 code available %	final sample N
2006	238597	69	47	99	73170
2007	309469	82	43	99	107754
2008	357371	83	37	99	106913
2009	393605	84	37	99	119717
2010	439279	86	38	99	139935
2011	472010	84	38	99	149004
2012	493927	84	36	99	147742
2013	494609	85	32	99	133443
2014	516250	85	34	99	144049
2015	532169	87	32	99	145141
Total	4247286	84	36	99	1266868

TABLE A7. DISCREPANCIES BETWEEN POSTCODE AND CITY NAME BASED NUTS3 CODES

	Nr. of contracts with non-missing NUTS3 based on postcode and settlement name	Percent of contracts with the same NUTS3 based on postcode and settlement name
AT	23939	98
BE	49464	99
BG	38	100
CZ	22845	85
DE	241212	98
DK	28159	92
EE	12913	100
ES	180841	100
FI	49365	100
FR	1049985	100
GR	44	100
HR[29]	6834	40
HU	54375	100
IT	163219	99
LU	7146	100
LV	64516	99
MT	1239	100
NL	21064	100
PL	713993	100
PT	2972	87
RO[30]	145825	63
SE	75727	100
SI	53874	100
SK	4418	88
UK[31]	37966	45
Total	3011973	97

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[29] In Croatia, the "Percent of contracts with the same NUTS3 based on postcode and settlement name" is low because there are discrepancies between the postcode-NUTS and city-NUTS tables. For example, Rijeka has different NUTS3 codes in the two correspondence tables.

[30] In Romania, the "Percent of contracts with the same NUTS3 based on postcode and settlement name" is low because there are discrepancies between the postcode-NUTS and city-NUTS tables as released by Eurostat. For example, Bucharest has different NUTS3 codes in the two correspondence tables.

[31] In the UK, in only 12% of contracts could be assign NUTS codes based on both settlement name and postcode. For this small sample, the "Percent of contracts with the same NUTS3 based on postcode and settlement name" is low. A major reason for this high discrepancy is the plain disagreement between the two correspondence tables released by Eurostat.

	Nr. of contracts with non-missing NUTS3 based on postcode and settlement name	Percent of contracts with the same NUTS2 based on postcode and settlement name
AT	23939	99
BE	49464	100
BG	38	100
CZ	22845	86
DE	241212	99
DK	28159	98
EE	12913	100
ES	180841	100
FI	49365	100
FR	1049985	100
GR	44	100
HR	6834	98
HU	54375	100
IT	163219	100
LU	7146	100
LV	64516	100
MT	1239	100
NL	21064	100
PL	713993	100
PT	2972	96
RO	145825	63
SE	75727	100
SI	53874	100
SK	4418	90
UK	37966	46
Total	3011973	97

APPENDIX B: ADDITIONAL DESCRIPTIVE STATISTICS AND FIGURES

TABLE B1. DESCRIPTIVE STATISTICS OF RAW INDICATORS, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS

Variable	Mean	Std. Dev.	Min	Max	N
contract notice publication	68.93	16.00	10.55	100.00	1241
use of open procedures	85.77	13.00	7.98	100.00	1241
reporting completeness	91.87	5.93	67.14	99.97	1241
use of e-auctions	2.99	8.41	0.00	78.14	1241
voluntary reporting	18.30	16.47	0.00	79.89	1241
Number of bidders(trim.)	5.91	2.52	1.19	16.53	1241
non-local suppliers	29.49	18.03	0.00	96.00	1241
foreign suppliers	1.34	2.52	0.00	29.16	1241
decision making speed	-14.08	65.50	-558.33	69.97	1241
price savings	5.77	6.69	-40.06	31.07	1241
MEAT assessment criteria	-4.46	26.22	-64.44	55.08	1241
Corruption Risk Index*	65.73	17.16	0.00	100.00	1240

*Note: * Because the Corruption Risk Index is already used as a composite in the literature, we only report it as one variable rather than its components separately.*

FIGURE B1. HISTOGRAM OF THE PUBLIC SPENDING QUALITY SCORE, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS (N$_{REGIONS}$=1239)
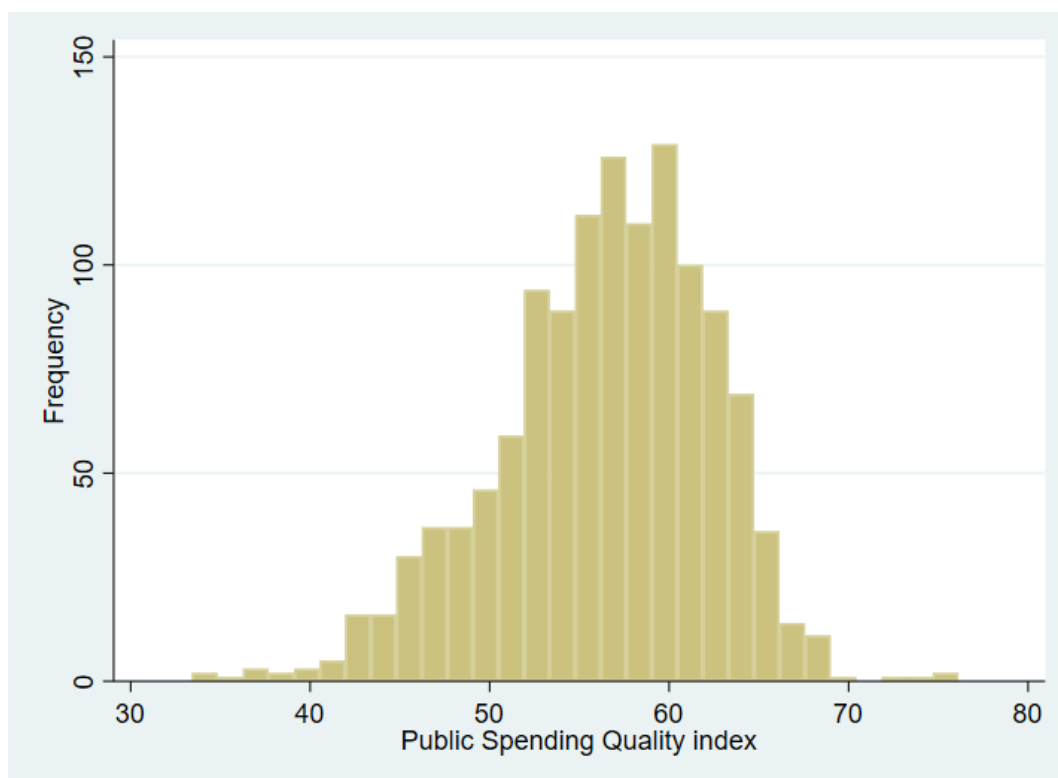
FIGURE B2. HISTOGRAMS OF THE COMPOSITE INDICATORS MAKING UP THE PUBLIC SPENDING QUALITY SCORE, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS ($N_{REGIONS}$=1241)
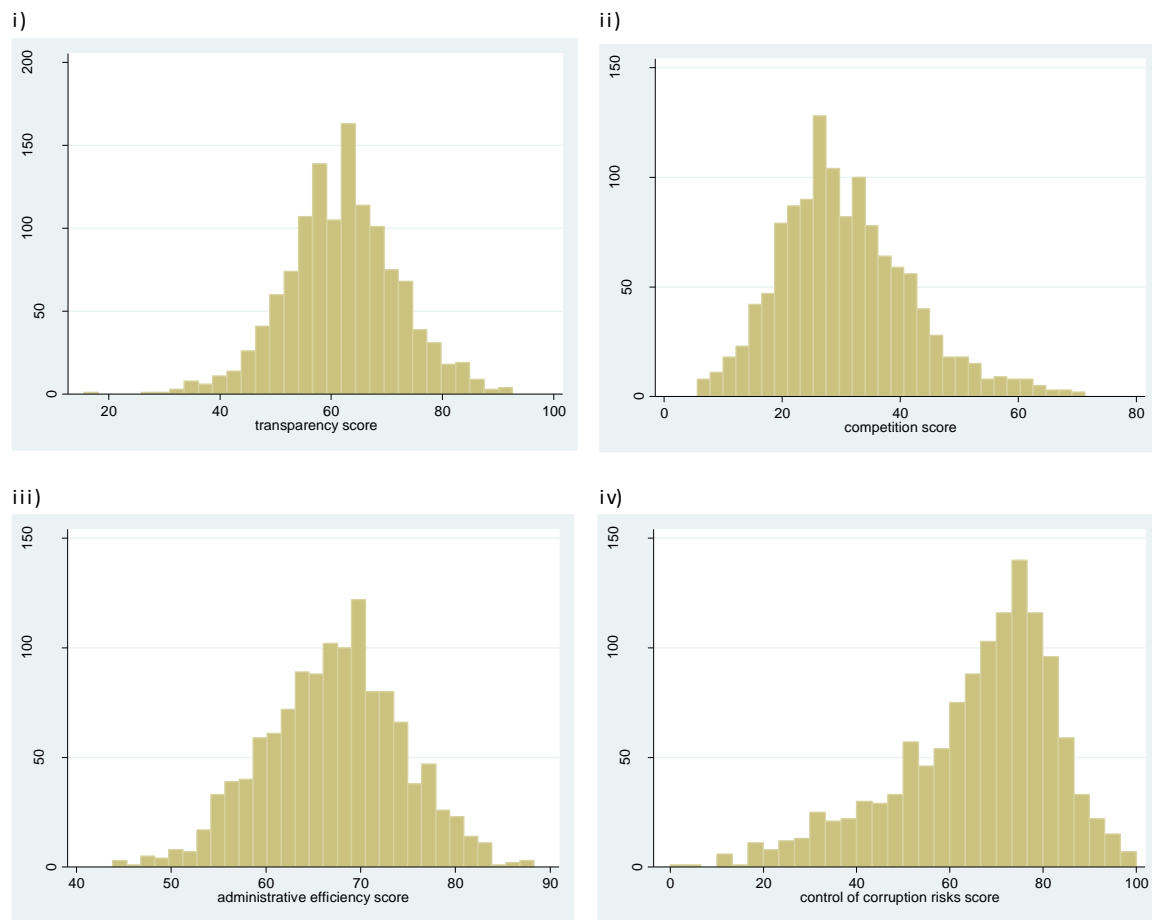
FIGURE B3. REGIONAL PUBLIC SPENDING QUALITY SCORE AND WITHIN-COUNTRY VARIATION, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS ($N_{REGIONS}$=279)
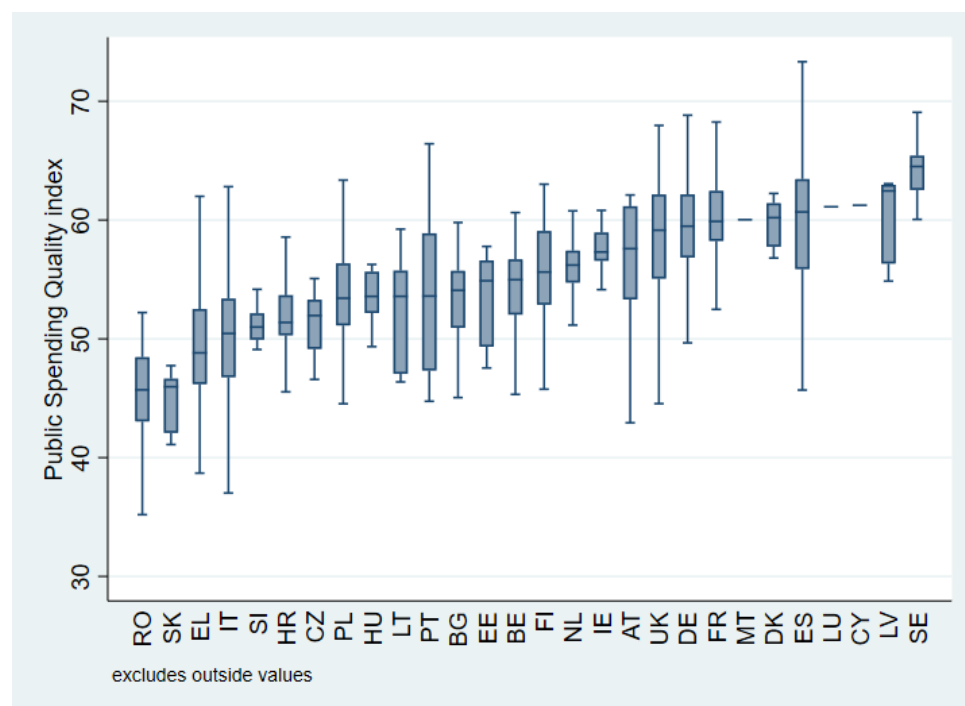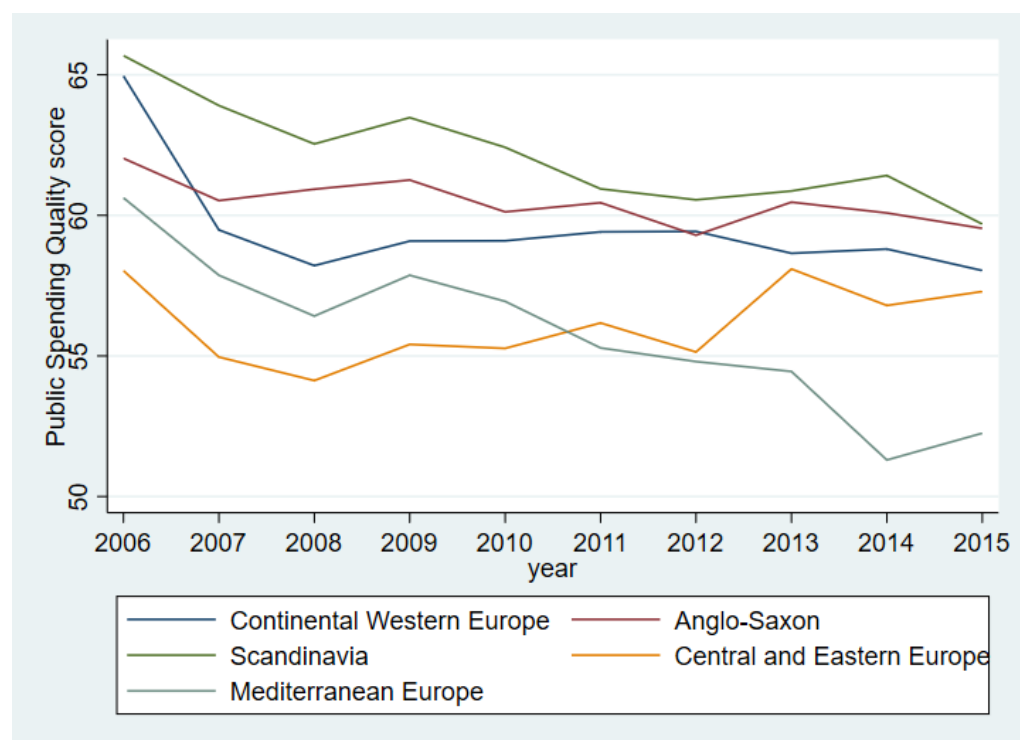

FIGURE B4. TRENDS IN THE AVERAGE PUBLIC SPENDING QUALITY SCORE ACROSS MACRO REGIONS OF THE EU, 2007-2015, TED

Note: Continental Western Europe includes AT, BE, DE, FR, LU, and NL; Anglo-Saxon denotes IE and UK; Scandinavia includes DK, FI, and SE; Central and Eastern Europe include BG, HR, CZ, CY, EE, HU, LV, LT, MT, PL, RO, SK, and SI; Mediterranean Europe denotes EL, IT, PT, and ES

TABLE B2. CORRELATIONS AMONG PUBLIC SPENDING QUALITY PILLARS, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS (N$_{REGIONS}$=1241), SIGNIFICANT COEFFICIENTS ARE SHOWN

	Public Spending Quality score	Transparency score	Competition score	Efficiency score	Control of corruption risks score
Public Spending Quality score	1.00				
Transparency score	0.16	1.00			
Competition score	0.49	-0.15	1.00		
Efficiency score	0.44	-0.25		1.00	
Control of corruption risks score	0.79	-0.16	0.10	0.31	1.00

FIGURE B5. SCATTERPLOT OF PUBLIC SPENDING QUALITY AND LOG GDP/CAPITA (PPS), NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N$_{REGIONS}$=274

FIGURE B6. SCATTERPLOTS AMONG PUBLIC SPENDING QUALITY PILLARS, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS (N_REGIONS=1241)
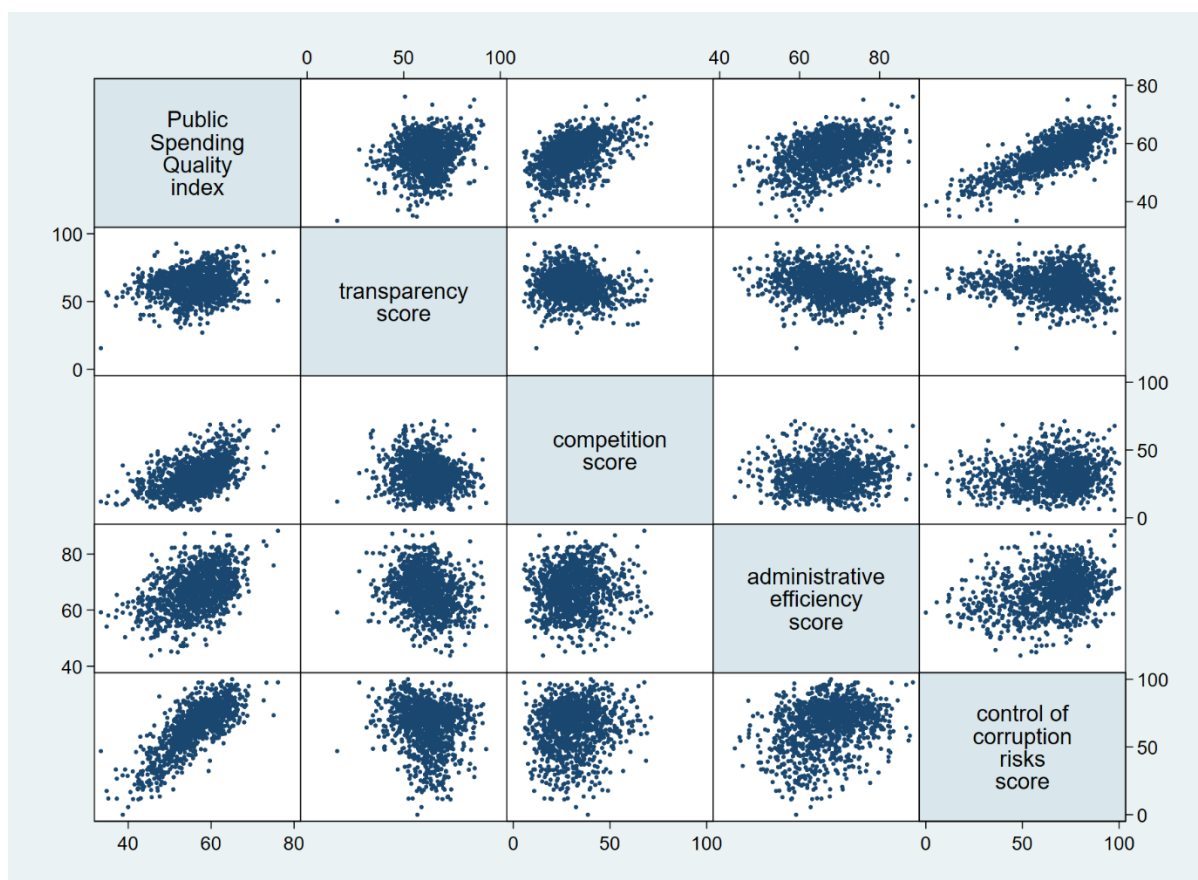

FIGURE B7. DECOMPOSITION OF COUNTRY-LEVEL PUBLIC SPENDING QUALITY SCORE INTO ITS COMPONENTS, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 35 AWARDED CONTRACTS (N_REGIONS=1241)
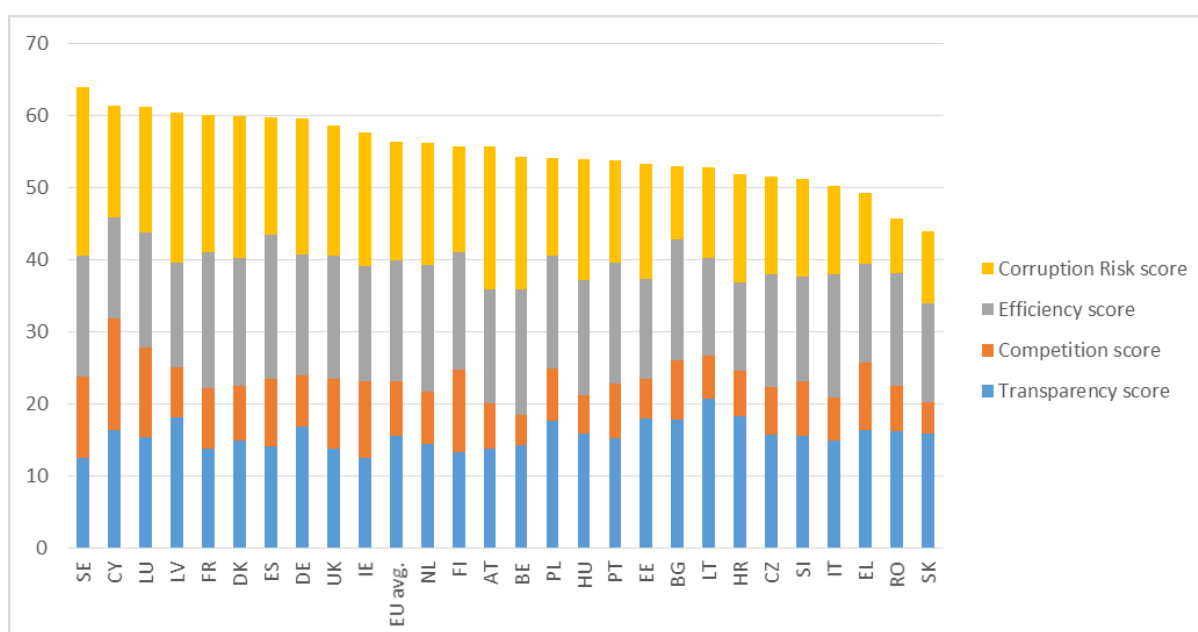
TABLE B3. LINEAR CORRELATION COEFFICIENTS OF PUBLIC SPENDING QUALITY AND OUTCOME VARIABLES, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N_REGIONS=274

	Public Spending Quality	log GDP per capita	avg. social trust	EQI	avg.publ.sec. meritocracy
Public Spending Quality	1				
log GDP per capita	0.3201*	1			
avg. social trust	0.3456*	0.5066*	1		
EQI	0.5400*	0.6002*	0.3688*	1	
avg. publ. sec. meritocracy	0.6056*	0.4960*	0.5948*	0.6872*	1

FIGURE B8. SCATTERPLOT OF PUBLIC SPENDING QUALITY AND SOCIAL TRUST, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N_REGIONS=274
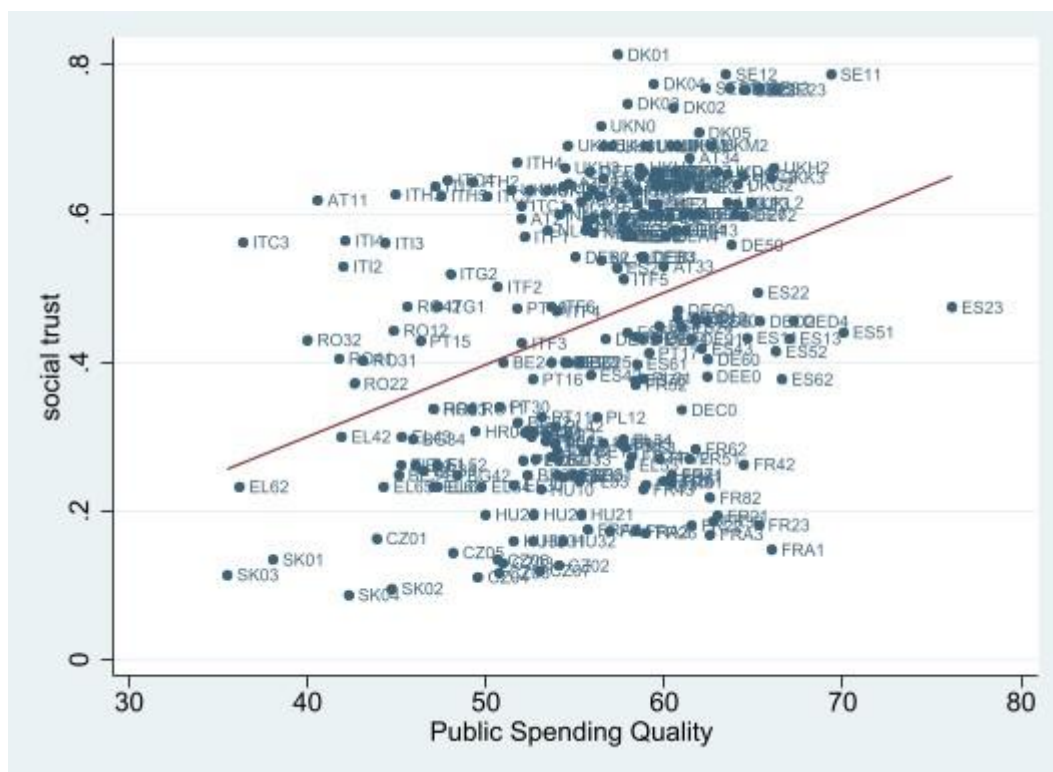
FIGURE B9. SCATTERPLOT OF PUBLIC SPENDING QUALITY AND PUBLIC SECTOR MERITOCRACY, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N_REGIONS=274
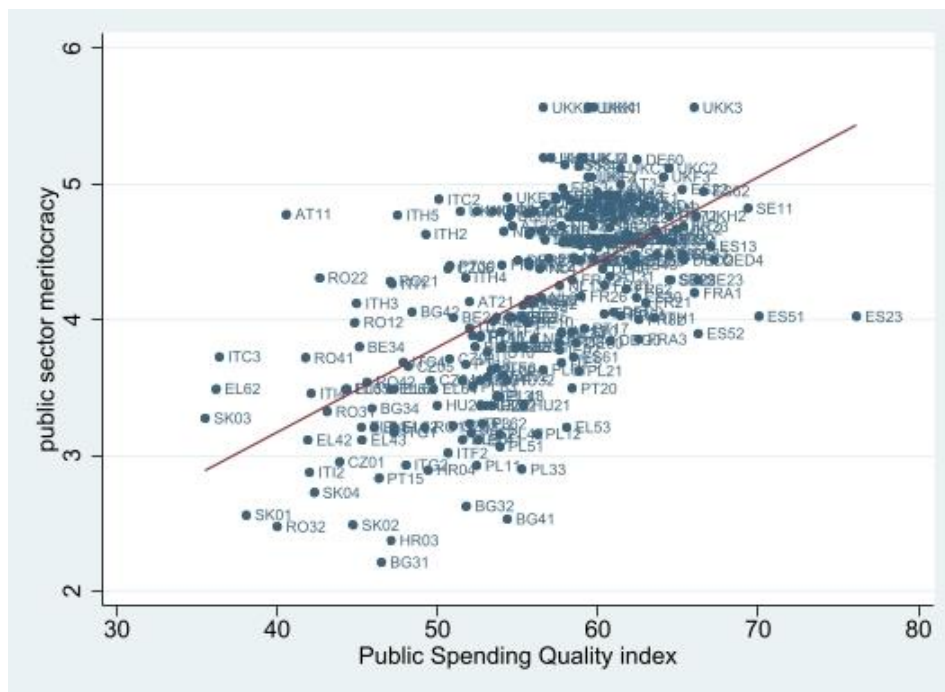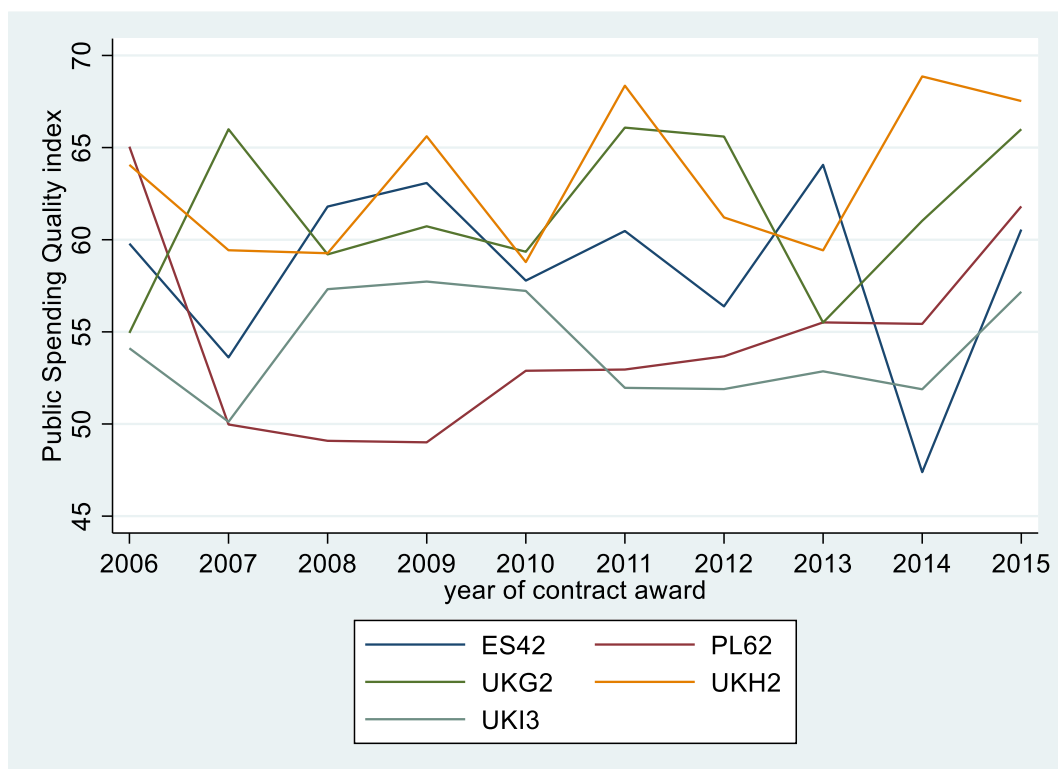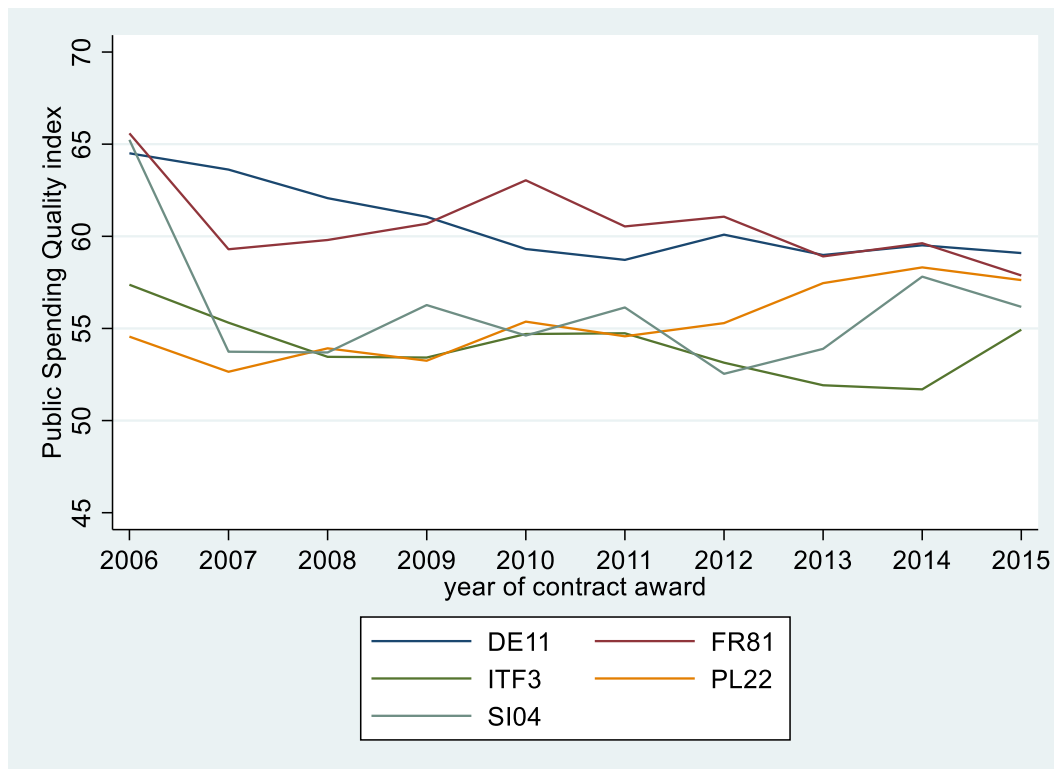

FIGURE B10. TIME SERIES PLOT OF NUTS2 REGIONS WITH THE LARGEST TEMPORAL VOLATILITY IN PUBLIC SPENDING QUALITY INDEX, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS, N_REGIONS=5

APPENDIX C: PRINCIPAL COMPONENT ANALYSIS RESULTS ON NUTS3 LEVEL

TABLE C1. STATISTICS OF EACH COMPONENT

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Principal components/correlation                Number of obs    =       1,238
                                                Number of comp.  =          10
                                                Trace            =          10
    Rotation: (unrotated = principal)           Rho              =      1.0000
```

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.4261	.803765	0.2426	0.2426
Comp2	1.62233	.392066	0.1622	0.4048
Comp3	1.23027	.17287	0.1230	0.5279
Comp4	1.0574	.196173	0.1057	0.6336
Comp5	.861224	.134764	0.0861	0.7197
Comp6	.72646	.0798445	0.0726	0.7924
Comp7	.646615	.0763122	0.0647	0.8570
Comp8	.570303	.0876147	0.0570	0.9141
Comp9	.482688	.106074	0.0483	0.9623
Comp10	.376614	.	0.0377	1.0000

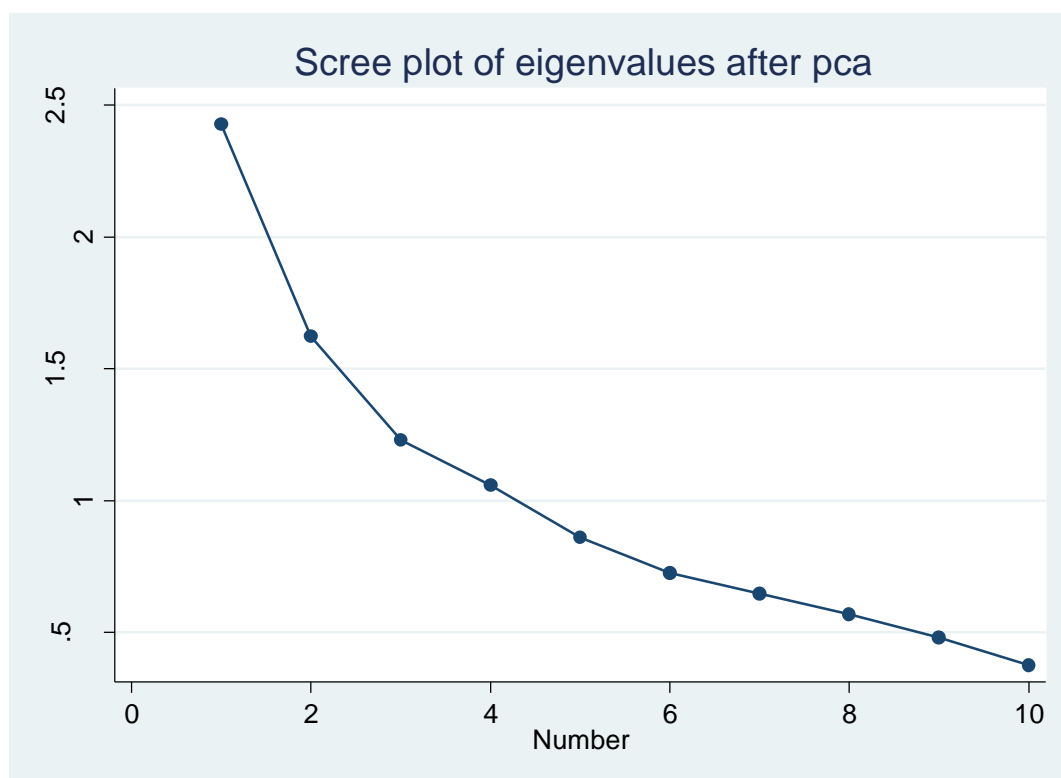**FIGURE C1. SCREE PLOT OF EIGENVALUES OF COMPONENTS**

TABLE C2. FACTOR LOADINGS FOR THE FIRST 4 COMPONENTS

	Comp1: corruption & competition (reverse scale)	Comp2: transparency & efficiency	Comp3: open competition	Comp4: open markets
contract notice publication	0.2671		0.554	
use of open procedures			0.7134	
reporting completeness	0.3929	0.2943		-0.2928
voluntary reporting		0.5666		
intensity of competition	-0.3938		0.3532	
non-local suppliers		-0.2905		0.7464
decision making speed	0.2153	0.4697		0.3863
price savings	0.2534	-0.2712		-0.4286
MEAT assessment criteria	-0.5001			
Corruption Risk Index*	0.4433	-0.3747		

*Note: * Because the Corruption Risk Index is already used as a composite in the literature, we only report it as one variable rather than its components separately.*

APPENDIX D: ROBUSTNESS TESTS

In order to briefly test the robustness of our indicators to sample size restrictions, some of the above tables are replicated on much smaller samples including regions with a higher number of awarded contracts only. Both Table D1 and D2 confirm that results are not driven by small regions either when comparing different Public Spending Quality scores or when testing them against external indices.

TABLE D1. CORRELATIONS AMONG PUBLIC SPENDING QUALITY PILLARS, NUTS3, TED, 2006-2015, REGIONS WITH AT LEAST 100 AWARDED CONTRACTS (N$_{REGIONS}$=1002), SIGNIFICANT COEFFICIENTS ARE SHOWN (AT 5% LEVEL)

	Public Spending Quality score	Transparency score	Competition score	Efficiency score	Control of corruption risks score
Public Spending Quality score	1.00				
Transparency score	0.11	1.00			
Competition score	0.54	-0.16	1.00		
Efficiency score	0.45	-0.24	0.08	1.00	
Control of corruption risks score	0.80	-0.21	0.17	0.31	1.00

TABLE D2. CORRELATIONS AMONG PUBLIC SPENDING QUALITY PILLARS AND EXTERNAL INDICATORS OF REGIONAL QUALITY OF GOVERNMENT, NUTS2, TED, 2006-2015, REGIONS WITH AT LEAST 500 AWARDED CONTRACTS (N$_{REGIONS}$=242), SIGNIFICANT COEFFICIENTS ARE SHOWN (AT 5% LEVEL)

	GDP/capita	EQI (2010)	EQI (2013)	public sector meritocracy	social trust
Public Spending Quality score	0.15	0.59	0.60	0.59	0.29
Transparency score	-0.30	-0.26	-0.21	-0.27	-0.21
Competition score		0.28	0.29	0.40	0.38
Efficiency score		0.39	0.26	0.33	
Control of corruption risks score	0.31	0.71	0.68	0.58	0.28