

CHAPTER 12

Government Analytics Using Procurement Data

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SUMMARY

The digitalization of national public procurement systems across the world has opened enormous opportunities to measure and analyze procurement data. The use of data analytics on public procurement data allows governments to strategically monitor procurement markets and trends, to improve the procurement and contracting process through data-driven policy making, and to assess the potential trade-offs of distinct procurement strategies or reforms. This chapter provides insights into conducting research and data analysis on public procurement using administrative data. It provides an overview of indicators and data sources typically available on public procurement and how they can be used for data-driven decision-making, the necessary data infrastructure and capacity for optimizing the benefits from procurement data analytics, and the added value of combining public procurement data with other data sources. Governments can take various steps to create the conditions for effectively using data for decision-making in the area of public procurement, such as centralizing public procurement data, periodically assessing their quality and completeness, and building statistical capacity and data analytics skills in procurement authorities and contracting entities.

ANALYTICS IN PRACTICE

- The increasing availability of public procurement administrative microdata should be exploited for evidence-based decision-making. The digitalization of national public procurement systems across the world has opened enormous opportunities to measure procurement outcomes through the analysis of administrative data now available in machine-readable formats on electronic government procurement (e-GP) systems. The full potential of e-GP reforms can be realized when data analytical tools are systematically applied at scale for the monitoring and evaluation of public procurement.

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- Procurement data analytics can be used for monitoring and characterizing public procurement. Public procurement data can be used to characterize national public procurement spending; describe time trends; compare procurement performance across procuring entities, regions, and types of contract, as well as across types of procedure, sector, or supplier; and identify performance and compliance gaps in the national public procurement system. Interactive dashboards are increasingly widespread tools for monitoring public procurement through descriptive analysis because they enable procurement authorities to track, analyze, and display key performance indicators through customizable and user-friendly visualizations.
- Procurement data analytics can be used for data-driven policy making. The analysis of public procurement data can enable procurement agencies to develop key procurement policies or refine and assess existing regulations. First, data analytics allows agencies to assess existing efficiency gaps and understand the drivers of performance; these empirical insights are useful to identify and prioritize potential areas for interventions and reform efforts. Second, data analytics allows agencies to monitor the consequences of new policies, assess whether they are delivering the expected outcomes, and understand potential trade-offs. Especially in cases where an e-GP system already exists at the time of piloting and implementing new strategies, public procurement can also be a rich space for research and impact evaluations because the necessary data for tracking key outcome indicators are readily available from the existing e-GP system.
- Appropriate data infrastructure and capacity are necessary for effectively using public procurement data for decision-making. First, procurement data should be homogeneously collected and maintained across procuring entities and connected to a centralized platform. Second, data generated from different stages of the procurement cycle (for example, tendering process, bidding process, bid evaluation, contract award, and contract signing) should be consistently organized and connected through key identifiers. Third, the availability of data should be expanded to cover the full public procurement and contract management cycle, including parts of the process that are not typically included in procurement data, such as data on public procurement planning and budgeting, tender preparation data, contract execution data, and complaints data. Fourth, data quality and completeness should be improved through relatively simple and practical steps by the government, such as automated data quality checks in the e-GP system and periodic data audits. Finally, the necessary capacity for statistical analysis should be built in the public procurement authority, potentially including the creation of a dedicated statistical unit.
- A “whole-of-government” approach should be adopted in procurement data analytics. Public procurement is multidimensional and critically interconnected with other functions of the public sector and public administration. Yet the integration of e-procurement systems into other e-government systems is not yet a common practice. Data innovations should enable the integration of public procurement data with administrative microdata from other parts of the public sector, such as justice, firm registries, and tax administration. This would provide a comprehensive picture of the procurement function, holistically explore the environment within which procurement is conducted, and enable the government to develop innovative and impactful procurement strategies.
- Procurement data analytics should move beyond traditional public procurement indicators and data sources. While there is widespread consensus about the measurement framework for some dimensions of public procurement, including costs, price efficiency, integrity risks, transparency, and competition, other relevant aspects of public procurement, such as the inclusiveness and sustainability of public procurement and the quality of contract implementation, currently lack well-defined and commonly used indicators. Using nontraditional public procurement data can contribute to the development of new measures and expand the scope of public procurement data analytics, such as survey data with firms or procurement officers.

INTRODUCTION

While it is difficult to measure the size of public procurement transactions in each country, a global exercise by Bosio et al. (2022) estimates that around 12 percent of the global gross domestic product is spent on public procurement—the process by which governments purchase goods, services, and works from the private sector. Given this massive scale, public procurement has the potential to become a strategic policy tool in three crucial ways.

First, improved public procurement can generate sizeable savings and create additional fiscal space by reducing the price of purchases and increasing the efficiency of the procurement process (Bandiera, Prat, and Valletti 2009; Best, Hjort, and Szakonyi 2019; Singer et al. 2009).¹ Second, public procurement can support national socioeconomic and environmental aspirations by encouraging the participation of local small firms in the public contract market, promoting green and sustainable procurement, and creating jobs through large public works (Ferraz, Finan, and Szerman 2015; Krasnokutskaya and Seim 2011). Finally, efficient public procurement can improve the quality of public services through several channels, such as the selection of higher-quality goods, more timely delivery of goods and completion of public infrastructure, and better planning of purchases and stock management. Given these strategic functions, efficient and effective public procurement can contribute to the achievement of the development goals of ending poverty and promoting shared prosperity.²

Data and evidence are necessary to monitor public procurement spending and identify the optimal policies and strategies for efficient, inclusive, and sustainable procurement. The use of data can contribute to a problem-driven, iterative approach to strengthening and modernizing national public procurement systems through the identification of efficiency and integrity gaps, analysis of the trade-offs associated with alternative procurement strategies, the development of data tools for monitoring the public procurement function, and the generation of knowledge and evidence on the impact of certain policies.

The digitalization of national public procurement systems across the world has opened enormous opportunities to measure procurement outcomes through the analysis of administrative data now available in machine-readable formats on electronic government procurement (e-GP) systems. E-procurement refers to the integration of digital technologies to replace or redesign paper-based procedures throughout the procurement cycle (OECD 2021). While countries are increasingly digitalizing public procurement processes, the functionalities covered by e-GP systems vary widely across countries (box 12.1), and this has implications for the accessibility and quality of procurement and contract data for analysis and research. Map 12.1 shows advancements in e-GP adoption globally and highlights the different degrees of sophistication of national e-GP systems, depending on the extent to which various procurement stages—advertisement, bid submission, bid opening, evaluation, contract signing, contract management, and payment—can be implemented electronically.³

Governments can take various steps to create the conditions for effectively using data for decision-making in the area of public procurement, such as centralizing public procurement data, periodically assessing their quality and completeness, creating the data infrastructure for integrating data from various stages of the procurement cycle and from other e-government systems, measuring the socioeconomic and environmental dimensions of government purchases, integrating procurement data and systems into other e-government data and systems, and building statistical capacity and data analytics skills in procurement authorities and contracting entities.

This chapter provides insights and lessons on how to leverage administrative microdata for efficient and strategic public procurement. The chapter provides an overview of indicators and data sources typically available on public procurement and how they can be used for data-driven decision-making (section 2), the necessary data infrastructure and capacity for optimizing the benefits from procurement data analytics (section 3), and the added value of combining public procurement data with other data sources (section 4).

BOX 12.1 Types of Digitalization of Public Procurement Systems

The degree to which the procurement process is digitalized and integrated with other functions of government plays an important role in determining the accessibility and quality of administrative procurement microdata and how they can be used for conducting data analysis and research on public procurement.

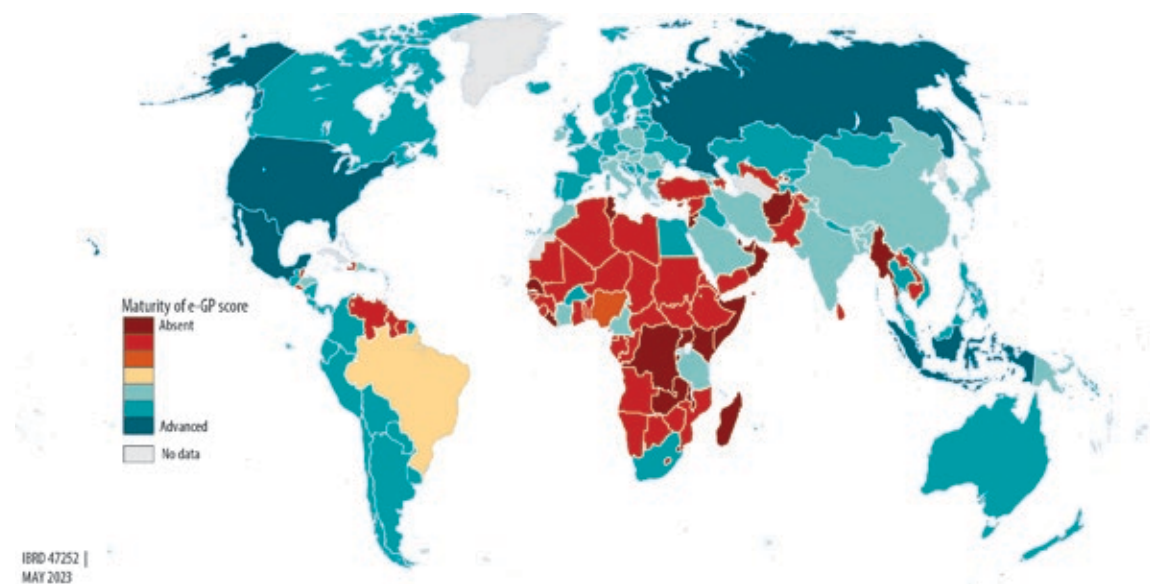
The digitalization of public procurement systems has been implemented in different ways across the world, with implications for data availability and quality. Most commonly, electronic government procurements (e-GP) systems are used to publish and store public procurement information. For example, in Pakistan and Tanzania, the online procurement system allows for the upload of tender and contract documents as scanned copies or PDFs.^a In these cases, data would first need to be scraped from PDF documents and organized in a structured manner before any kind of data analysis could be performed. In fewer countries, the e-GP system includes functionalities related to the transactional aspects of public procurement, such as e-tendering, electronic submission of bids, e-evaluation, e-awarding, and, in the most advanced cases, electronic submission of invoices, e-catalogs, and contract management. In these cases, the e-GP system generates data in machine-readable formats, readily available for analysis. For example, in Colombia, a data management system has been implemented following the Open Contracting Data Standard guidelines on data transparency, so the data from the e-GP system can be downloaded in the form of Excel files and readily used for analysis.^b

There are variations in the quality and completeness of data generated from e-GP systems, as well as in how well the data from different parts of the procurement process can be integrated or merged for a holistic view of government purchases. The integration of e-procurement systems into other e-government systems is not yet a common practice, and further work is needed to promote this “whole-of-government” approach from a data perspective.

a. For Pakistan, see World Bank (2017). For Tanzania, see the example of an invitation for bids from the Tanzania National Roads Agency (Tender AE/001/2020-21/HQ/G/79) available at https://www.afdb.org/sites/default/files/documents/project-related-procurement/invitation_for_tenders_-_edms.pdf.

b. For more information about the Open Contracting Data Standard, see the project website at <https://standard.open-contracting.org/latest/en/>.

MAP 12.1 Use of Electronic Government Procurements across the World, 2020



Source: World Bank, based on Doing Business 2020 Contracting with the Government database, <https://archive.doingbusiness.org/en/data/exploretopics/contracting-with-the-government#data>.

Note: The Maturity of e-GP score was calculated based on the number of features existing in the electronic government procurement (e-GP) system portal, as reported in the World Bank's Contracting with the Government database.

HOW DO WE USE PUBLIC PROCUREMENT DATA FOR DECISION-MAKING?

Procurement Indicators Used for Data Analysis

Based on the perspective that public procurement is a strategic function contributing to efficient public spending, as well as to the achievement of national socioeconomic and environmental objectives, this chapter provides a holistic view of public procurement. While the application of data analytical tools is often associated with the use of corruption flags to uncover malpractice, this focus risks discouraging governments from using and opening public procurement data. Data analytical tools' main purpose is strengthening the efficiency of public procurement and government spending in achieving national objectives, and a stronger focus on these more comprehensive goals could help reduce resistance from governments to adopting them.⁴ Following this view, in this section, we present a broad set of procurement indicators and uses of procurement data analytics corresponding to a wide range of objectives, including (but not only) anticorruption goals. Table 12.1 provides an example of public procurement indicators that can be used to measure the performance of the public procurement system along the dimensions described in the following paragraphs: economy and efficiency, transparency and integrity, competition, inclusiveness, and sustainability.

The procurement and contracting cycle refers to a sequence of related activities, from needs assessment through competition and award to payment and contract management, as well as any subsequent monitoring or auditing (OECD 2021). It is typically divided into the following stages: (1) budget planning and tender preparation; (2) tendering process, bidding process, and bid evaluation; (3) contract award and contract signing; and (4) contract execution and monitoring. Traditional public procurement data often cover only stages (2) and (3) because the other stages are typically managed by other units (budget and financial management) and therefore recorded in separate systems. These data can be organized at the tender, lot, item (product), bid, and contract levels. Figure 12.1 provides a visual representation of how the different levels of public procurement data connect. Specifically, tenders can be divided into lots, and each lot can specify different product items. Firms submit bids to specific tenders or lots and can submit for specific tenders; tenders result in one or more contracts, which are then linked to contract amendments and payments. Understanding the structure of public procurement data and the links between different stages is the first step for effectively using and analyzing it. For example, the e-GP systems for Brazil, Romania, Croatia, and Honduras organize open procurement data at the tender, lot, contract, and bid levels, allowing users to connect these different stages of the process through unique identifiers for each data set.

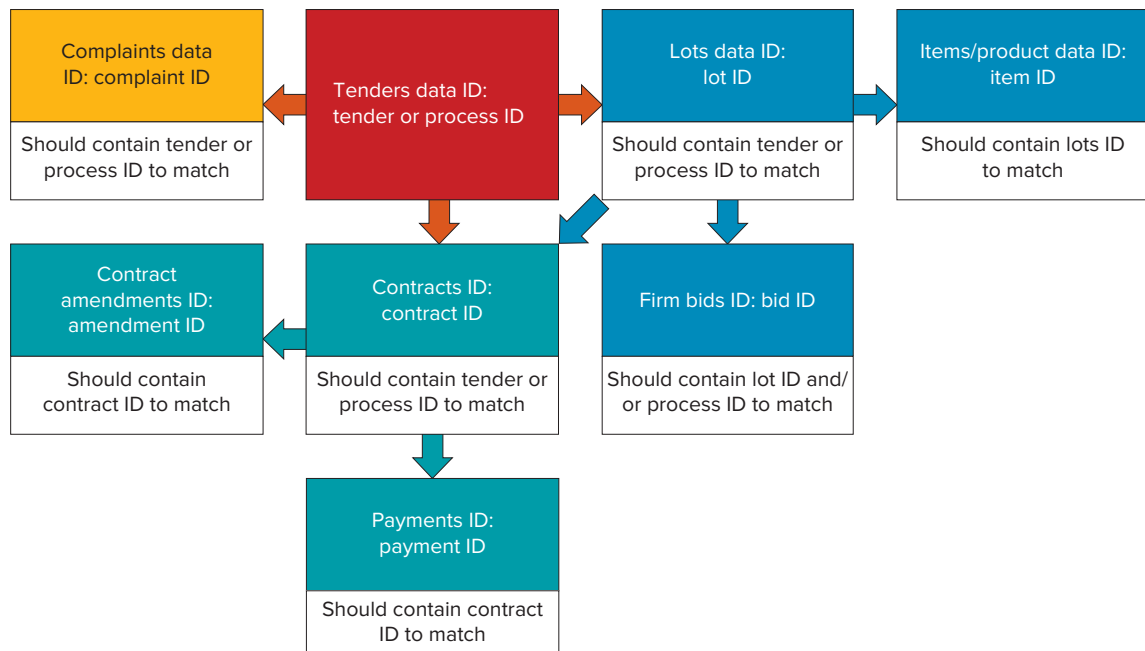
TABLE 12.1 Examples of Public Procurement Indicators

Economy and efficiency	Transparency and integrity	Competition	Inclusiveness and sustainability
<i>Tender and bidding process</i>			
<ul style="list-style-type: none"> Total processing time Evaluation time Contracting time 	<ul style="list-style-type: none"> Time for bid preparation Single-bidder tender 	<ul style="list-style-type: none"> Open procedure Number of bidders Share of new bidders 	<ul style="list-style-type: none"> Share of SME bidders Share of WOE bidders
<i>Assessment and contracting</i>			
<ul style="list-style-type: none"> Awarded unit price Final unit price after renegotiation 	<ul style="list-style-type: none"> Share of excluded bids 	<ul style="list-style-type: none"> Number of bidders New bidders 	<ul style="list-style-type: none"> Share of SME bidders Share of WOE bidders
<i>Contract implementation</i>			
<ul style="list-style-type: none"> Final unit price after renegotiation Time overrun 	<ul style="list-style-type: none"> Variation orders Renegotiations 		

Source: Original table for this publication.

Note: SME = small and medium enterprise; WOE = women-owned enterprise.

FIGURE 12.1 Data Map of Traditional Public Procurement Data



Source: Original figure for this publication.

The academic literature and practitioners in the field have identified a common set of indicators that are typically used to measure the efficiency, effectiveness, and integrity of the public procurement function. These indicators cover dimensions of public procurement related to methods and procedures (for example, use of open methods), transparency and integrity (for example, time for bid submission), competition (for example, number of bidders), processing time (for example, time for bid evaluation), price (for example, unit prices), and contract implementation (for example, time overrun). (A full list of indicators is provided in appendix D.) In addition to performance indicators, public procurement microdata can also be used for the construction of red flags for corruption or collusion risk. The richness of the data available on public tenders has allowed economists, anticorruption authorities, and competition agencies to develop different screening techniques and has offered the opportunity to test them empirically. Red flags can be useful to identify unusual patterns in certain markets, but these patterns are not sufficient evidence of misbehavior. Rather, red flags can be used as the starting point for further investigation and as sufficient evidence for courts to authorize inspections of dawn raids (OECD 2013). One reason why red flags cannot provide sufficient proof of corruption or collusion is that by design, these data-driven methods can produce false positives (by flagging cases that do not merit further scrutiny) and false negatives (by failing to identify cases that do merit further scrutiny). Given that corruption risk indicators and cartel screens do not directly point to illegal activities, establishing their validity is of central importance.⁵ Boxes 12.2 and 12.3 present the existing literature on corruption risk indicators and cartel screens and some recent advances in these techniques thanks to novel machine-learning applications.

Beyond a transactional view of public procurement, there is increasing interest in measuring dimensions of public procurement related to the strategic role it can play to promote inclusive and sustainable growth and the achievement of socioeconomic and environmental objectives. Recent studies and research on these topics have focused both on the development of new procurement indicators (for example, on green procurement and socially responsible procurement) and on linking public procurement data with other data sources to promote a holistic approach to data analytics (for example, firm registry microdata). These topics are discussed in more detail in section 5.

An area that would require further development and research is the measurement of contract implementation quality. Various approaches have been experimented with in the literature, but there

is no agreed-upon strategy yet, and this is a dimension where data constraints are particularly binding. One option would be to use audits data, but the limitations are that audits often focus on compliance with procurement regulations rather than on actual project implementation and that audits data are not typically integrated with public procurement data. Contract supervision data and project management reports could also be used to generate information on contract implementation. The potential for integrating data from various stages of the public procurement cycle and from other functions of the state is discussed further in section 4. Ad hoc data collection could also be considered for specific sectors—for example, through engineering assessments of the material used for the construction of infrastructure projects (Olken 2007) or through visits to hospitals to verify the availability of medicines and their quality. With respect to the construction sector, recent advances in technology (for example, drones and satellite images) can monitor the progress—but not necessarily the quality—of construction work, while information on quality can be obtained from citizen monitoring. More work is needed to assess the pros and cons of different measurement strategies, particularly in terms of the objectivity of different measurement approaches and their scalability.

BOX 12.2 What We Know about Corruption Risk Indicators

The starting point for measuring any corrupt phenomenon is to define the particular behaviors of interest (Mungiu-Pippidi and Fazekas 2020). In public procurement, one definition widely used in both academia and policy considers corruption to be the violation of impartial access to public contracts—that is, a deliberate restriction of open competition to the benefit of a connected firm or firms (Fazekas and Kocsis 2020).

Corruption risk indicators identify the factors and traces of corrupt transactions defined by deliberate competition restrictions favoring connected bidders. Widely used corruption risk indicators in public procurement include single bidding in competitive markets, restricted and closed procedure types, or the lack of publication of the call for tenders (Fazekas, Cingolani, and Tóth 2018). These risk indicators have been shown to correlate with already established indexes of corruption, such as the Control of Corruption scores in the Worldwide Governance Indicators (Fazekas and Kocsis 2020), as well as with other markers of corruption, such as the price of auctions (Fazekas and Tóth 2018), the political connections of bidding firms (Titl and Geys 2019), and proven cases of corruption (Decarolis et al. 2020).

Novel machine-learning applications have been used to advance the measurement of corruption risks. For example, machine-learning approaches have been used on carefully curated data sets of proven corrupt and noncorrupt cases to train algorithms predicting corruption risks (Decarolis and Giorgiantonio 2022; Fazekas, Sberna, and Vannucci 2021). Advanced network science methods have also been increasingly used to detect high-corruption-risk groups of organizations (Wachs, Fazekas, and Kertész 2021).

Corruption risk indicators have been used in numerous civil society and journalistic applications, as well as by multilateral banks and national authorities for policy design and implementation. For example, the European Commission and Organisation for Economic Co-operation and Development's (OECD) Support for Improvement in Governance and Management (SIGMA) initiative (OECD and SIGMA 2019) has regularly monitored some risk indicators, such as single bidding and the publication of calls for tenders. The International Monetary Fund (IMF) has endorsed corruption risk indicators and models predicting the price impacts of such risks as valuable inputs to addressing macrocritical risks. The European Investment Bank uses public procurement risk indicators, combined with internal financial risk assessments, to select projects for prior integrity reviews (Fazekas, Ugale, and Zhao 2019), an approach highlighted as good practice by the European Court of Auditors (Adam and Fazekas 2019).

BOX 12.3 What We Know about Collusion and Cartel Screens

The characteristics of collusive behavior in public procurement markets are similar to those in conventional markets: companies coordinate their behavior regarding price, quantity, quality, or geographic presence to increase market prices.

Cartel screens are defined according to two key competition and economy principles. First, it is expected that in competitive tendering processes, bids will be submitted independently; therefore, signs of coordination between bidders can be interpreted as signs of collusion. Second, bids submitted by independent competitors should appropriately reflect the costs of each bidder in a competitive market. Based on these two criteria, various elementary collusion risk indicators have been developed for the early detection of collusive bidding, such as the submission of identical bids, high correlation between bids, lack of correlation between the costs and the bid submitted by each bidder, the relative difference between the lowest and the second lowest bid price per tender, the relative standard deviation of bid prices per tender, and the range of submitted bid prices per tender.

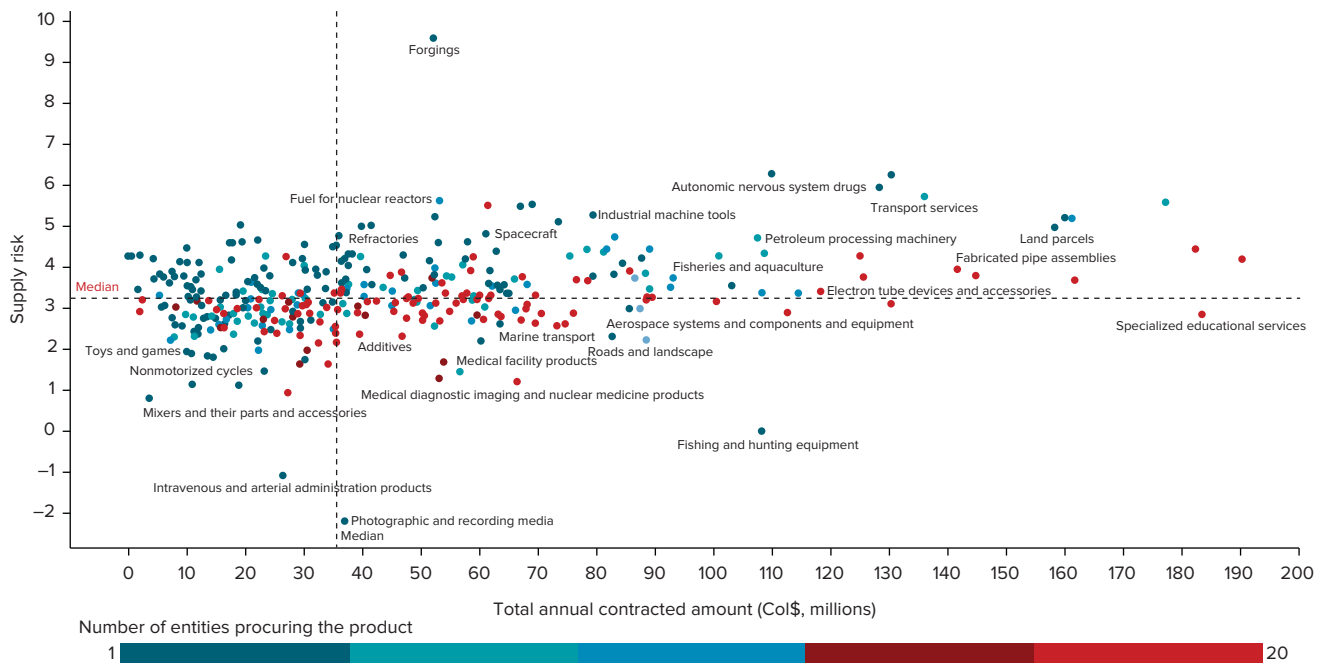
Increasingly, more advanced statistical techniques have been used to define cartel screens as well as develop algorithms that minimize the probability of both false positives and false negatives. For example, Conley and Decarolis (2016) have developed statistical tests of coordination based on randomization inference methods. These tests identify unexpected firm behaviors conditional on their characteristics—for example, the unexpected joint entry of firms within a group of bidders given observed firm and process characteristics. Huber and Imhof (2019) study the performance of different screening algorithms, specifically a lasso logit regression and a weighted average of predictions based on bagged regression trees, random forests, and neural networks. Most interestingly, these recent examples use machine-learning techniques to identify optimal algorithms thanks to the combination of public procurement data and judicial and auctions data for validation.

Government Monitoring of Public Procurement

With the increasing use of e-GP systems and access to structured procurement data, public procurement authorities are often using the common procurement indicators discussed in appendix D to monitor the performance of their own public procurement systems. These public procurement authorities use the available procurement data to characterize national public procurement spending and identify performance and compliance gaps in the national public procurement system. This descriptive analysis can include time trends or comparisons of performance indicators across procuring entities, regions, and types of contract, as well as types of procedure, sector, or supplier. In some cases, this exercise may be mandated by international treaties or organizations, or as a prerequisite to access financing from multilateral development banks.⁶ The results of this monitoring are often reported in the form of annual reports on the functioning of the procurement system, and they can be used for informing and guiding reform efforts and the development of new strategies and policies in public procurement. For example, in Poland, the Public Procurement Office (PPO) prepares the annual report on the functioning of the procurement system, which is posted on the PPO website following approval by the Council of Ministers.⁷

Public procurement agencies may use certain tools or mechanisms to describe their procurement data and trends. For example, spend analysis is a widespread approach for monitoring and assessing public procurement, consisting of various tools (for example, the Kraljic matrix; see figure 12.2) that provide a first overview of the procurement market and, specifically, what is being purchased, by whom, and from which suppliers. This analysis is used to identify the areas (products, entities, and suppliers) for which the improvement of efficiencies is expected to have the largest budget implications, to define procurement strategies, and to adapt relationship management for different types of suppliers.

FIGURE 12.2 Kraljic Matrix for Colombia

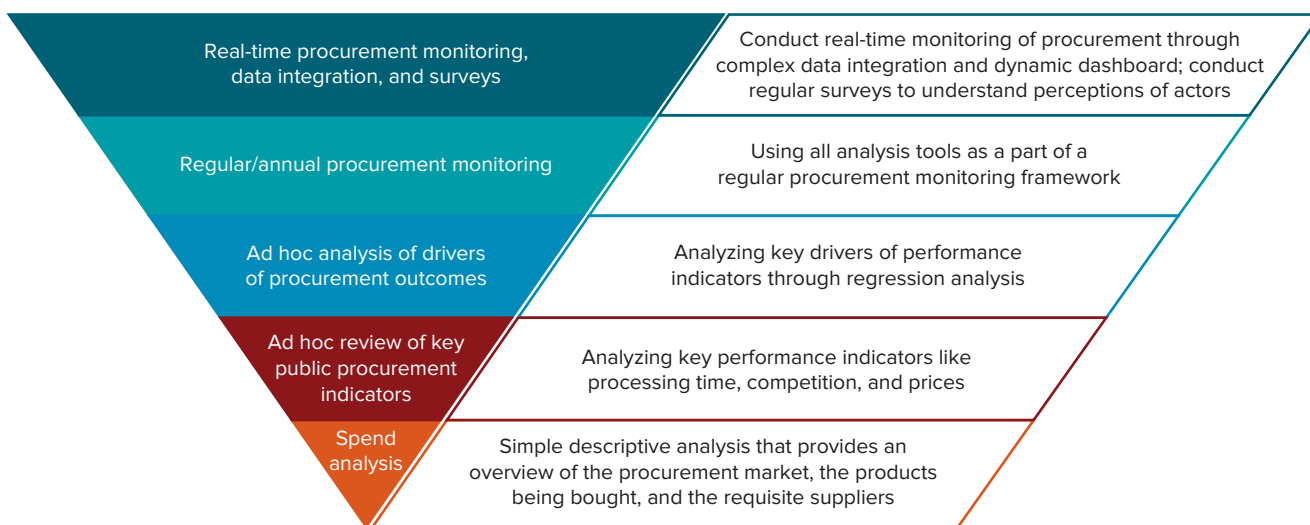


Source: Original figure for this publication based on Colombia's open public procurement data.
 Note: Col\$ = Colombian peso.

The analysis of performance and compliance offers another set of tools typically used by public procurement authorities and audit authorities to monitor the national public procurement system. This monitoring may include the compliance of procurement regulations as reported by procurement agencies.⁸ This type of descriptive analysis explores efficiency indicators, like competition, price, and processing time, as well as the extent to which procurement regulations (for example, regulations on contract thresholds, the use of open participation methods, or the use of centralized procurement methods) are met. This type of analysis is useful to describe the efficiency gaps that exist in the public procurement system and to help prioritize audit activities. For example, Best, Hjort, and Szakonyi (2019) show that in Russia, individuals and organizations of the bureaucracy together account for more than 40 percent of the variation in prices paid and that moving the worst-performing quartile of procurers to 75th percentile effectiveness would reduce procurement expenditures by around 11 percent, or US\$13 billion each year.

As illustrated in figure 12.3, these descriptive analysis tools are the least complex uses of public procurement administrative data. Figure 12.3 shows a ladder for analysis tools in procurement monitoring, in which each step of the ladder represents analytical tools conducted on procurement at different levels of complexity. Beyond descriptive analytics, diagnostic analysis (for example, regression analysis) can be used to identify the drivers of performance and therefore inform the government of potential strategies to improve efficiency and integrity. The following section discusses in detail diagnostic analysis tools for data-driven policy making. However, descriptive analysis tools can still be among the most advanced uses of public procurement when they are systematically embedded in the public procurement monitoring and reporting function—for example, for the preparation of annual reports or through interactive dashboards, which typically require institutional reorganization and the acquisition of necessary skills in the public procurement authority.

FIGURE 12.3 Complexity Ladder for Analysis Tools in Procurement Monitoring and Evaluation



Source: Original figure for this publication.

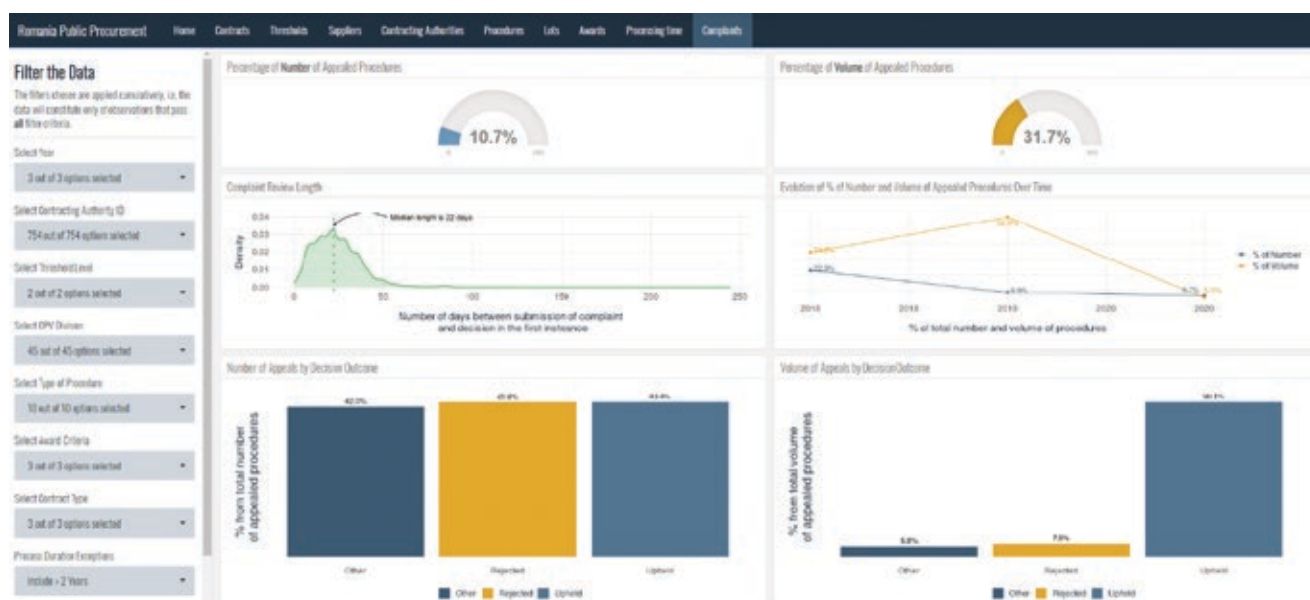
Interactive dashboards are increasingly widespread tools for monitoring public procurement through descriptive analysis because they enable procurement authorities to track, analyze, and display key performance indicators through customizable and user-friendly visualizations. One of the great advantages of these dashboards is that they allow users to focus their analysis at different levels of government or in specific markets. Depending on how the public procurement system is set up, these interactive dashboards can be connected directly with the underlying e-GP system or can be regularly updated. These dashboards can be built for the use of the national public procurement authorities and individual procuring entities for monitoring their procurement activity, or they can be made public for greater accountability of the public procurement system.

For example, between 2020 and 2021, the World Bank worked with the National Agency for Public Procurement (ANAP) in Romania to develop a monitoring mechanism, in the form of a dashboard that would enable the public procurement agency to track its own key performance indicators and would enable easy reporting to the EU (World Bank 2019). The dashboard (figure 12.4) was developed in close collaboration with the ANAP to ensure that the most relevant indicators were captured. Regular data analysis workshops conducted by the World Bank ensured that staff in the ANAP had the capacity and training to replicate and add to the dashboard to ensure its sustainability in the long run.

Data-Driven Policy Making

The analysis of public procurement data can enable procurement agencies to develop key procurement policies or refine and assess existing regulations. Data analytics allows agencies to assess existing efficiency gaps and understand the drivers of performance, and these empirical insights are useful to identify and prioritize potential areas for interventions and reform efforts. For example, in 2019, the World Bank conducted a complete and comprehensive analysis of Uruguay's public procurement data that generated discussion and space for policy recommendations to improve the performance of the procurement system. This analysis identified demand consolidation as the most significant potential source of savings, with framework agreements being the most effective instrument to implement the strategy. Based on these empirical insights, in 2021, the World Bank worked with the Regulatory Agency for Public Procurement and the Central Procurement Unit within the Ministry of Economy and Finance to implement these recommendations, specifically building capacity in the generation and management of framework agreements and supporting the development of pilot framework agreements for goods and services with the greatest savings potential.

FIGURE 12.4 National Agency for Public Procurement (ANAP) Dashboard, Romania



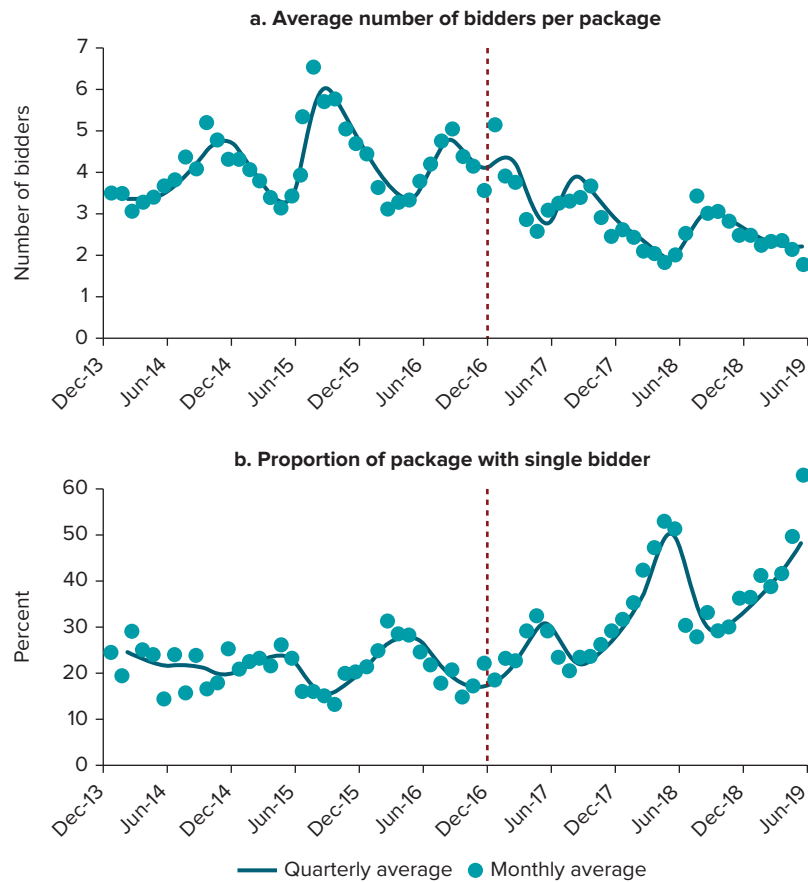
Source: Screenshot of the ANAP dashboard, World Bank 2019.

Data analytics is also a useful tool to monitor the consequences of new policies, assess whether they are delivering the expected outcomes, and understand potential trade-offs. For example, in 2020, the World Bank worked on an assessment of the national public procurement system in Bangladesh, the objectives of which were to identify its strengths and weaknesses, formulate appropriate mitigation measures for identified gaps, and develop an action plan for future system development (World Bank 2020). The assessment was built on various data-driven components, such as an analysis of the so-called 10 percent rule (rejecting a tender that is 10 percent below or above the estimated cost) introduced by the government of Bangladesh in December 2016 for the procurement of works using the open tendering method. The primary objective of this policy was to improve the quality of construction works and reduce the risk of cost overruns by restricting bidders from quoting very low prices. However, procuring entity officers largely expressed the opinion that the quality of works had not improved after the introduction of the 10 percent rule, and quantitative analysis of time trends also revealed that this rule had produced undesired consequences, such as decreasing competition (figure 12.5). These empirical insights were instrumental in providing fact-based recommendations to the government about reevaluating the 10 percent rule.

With respect to understanding potential trade-offs, increasing attention toward the multidimensional nature of public procurement implies that policies and strategies should be assessed based on a variety of considerations, including efficiency, integrity, value for money, and socioeconomic and environmental aspects. There are many trade-offs associated with the public procurement function in connection to the private sector and public service delivery, and a comprehensive approach to procurement data analytics allows agencies to correctly assess the potential trade-offs associated with procurement policies and provide complete and accurate policy recommendations. For example, a 2021 World Bank report on the use of framework agreements (World Bank 2021a) shows that in Brazil, the use of framework agreements could reduce unit prices and avoid repetitive processes, but it could also discourage participation by small and medium enterprises (SMEs) and their likelihood of being awarded a contract (table 12.2).²

These examples show that quantitative analysis can be quite powerful in identifying key procurement trends in a country and can be foundational in developing and evaluating procurement policies. Given the

FIGURE 12.5 Assessment of Bangladesh’s 10 Percent Rule



Source: World Bank 2020.

TABLE 12.2 Regression Analysis of Framework Agreements versus Other Open Methods, Brazil

Outcome of interest	Unit price (log)	SME winner
Framework agreements vs. other open methods	-0.0919** (0.0407)	-0.0198*** (0.00582)
Observations	172,605	166,399
R-squared	0.910	0.566

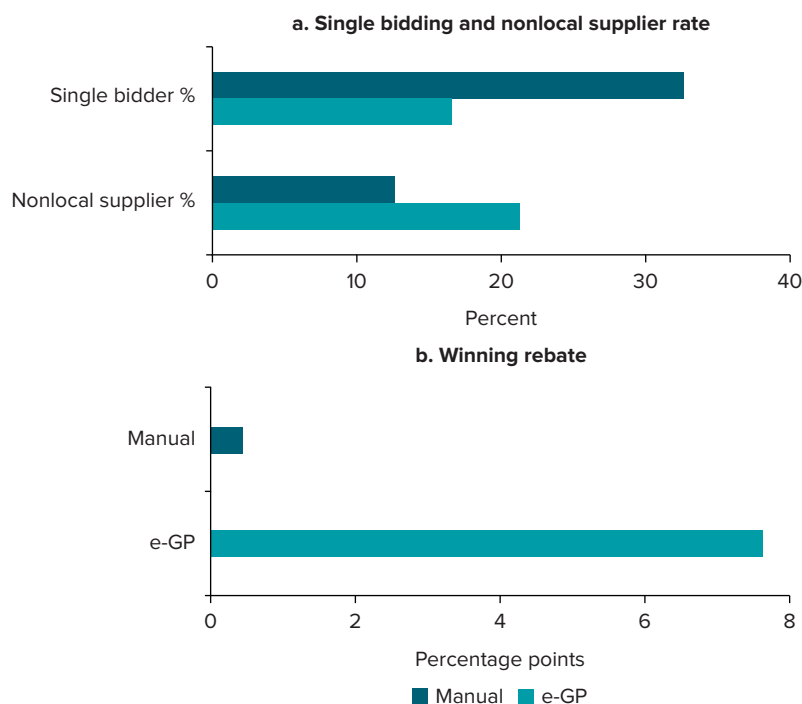
Source: World Bank 2021a.

Note: Model specifications: Comparing FAs and non-FA open methods for the purchase of the same product by the same entity (product—entity FE), with year and quarter FEs. FA = framework agreement; FE = fixed effect; SME = small and medium enterprise. Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

abundance of microdata in countries with e-GP systems, public procurement can also be an ideal space for implementing impact evaluations of specific procurement policies. Impact evaluations represent one of the most reliable forms of policy assessment because they allow agencies to contrast actual outcomes with counterfactual scenarios by comparing units subjected to a given policy intervention to otherwise similar units that have not yet been treated.

For example, starting in 2011, the government of Bangladesh began the rollout of a comprehensive e-GP system, and the World Bank worked with the Central Procurement Technical Unit to evaluate the impact of the new system on procurement outcomes.¹⁰ The evaluation revealed that the implementation of the e-GP system had led to an improvement in public procurement performance, as demonstrated, for example, by an increase in winning rebates, a decrease in single bidding, and an increase in contracts awarded to nonlocal suppliers (figure 12.6). During the piloting stage, the preliminary results from the evaluation

FIGURE 12.6 Procurement Outcomes under Manual versus Electronic Government Procurement Systems, Bangladesh



Source: Turkewitz, Fazekas, and Islam 2020.
 Note: e-GP = electronic government procurement.

helped demonstrate that the new e-GP system was having a good impact on efficiency, transparency, and competition, and this was extremely useful to build consensus and political support around this difficult reform (Turkewitz, Fazekas, and Islam 2020). This example demonstrates the feasibility and usefulness of impact evaluations for navigating the political economy of reforms. Specifically for public procurement, the abundance of data generated by the e-GP system creates a rich space for research because the data already available from the existing e-GP system at the time of piloting and implementing new strategies allow for the tracking of procurement outcomes, from baseline to endline, with no additional costs for data collection.

Monitoring of Public Procurement by the Public

Public procurement is one of the public administration functions with a prevalence of publicly available data. With the increase in the use of e-GP systems, there is greater potential for increasing transparency and accountability in public procurement processes through monitoring by the public. Open data can be used by civil society, the media, and citizens to acquire information on specific contracts, buyers, or products.¹¹ Increased transparency and accountability can enable citizen engagement in monitoring public procurement and, therefore, enhance trust between citizens and the state, strengthen the social contract, and improve the quality of contract execution. For example, a citizen engagement project was implemented by the World Bank in collaboration with the Central Procurement Technical Unit in Bangladesh to enable and support the monitoring of civil works projects by local community groups (Hassan 2017). Through the project, “citizen committee” members frequently visited project offices and reported anomalies in civil works projects to the engineer’s office. The project reduced information gaps and increased trust between government officials and local community leaders on civil works projects in their areas, and it also reduced monitoring-related transaction costs through higher citizen engagement.

Making public procurement data available to the public has great potential to increase transparency and accountability. However, even when data are publicly available online, it may be challenging to extract useful

and actionable information from open public procurement data, which requires connecting data sources from different stages of the procurement cycle, constructing relevant indicators, and analyzing microdata for large numbers of tenders and contracts. In light of these challenges, various international organizations have been developing dashboards to ease access to public procurement data for citizens, civil society, and researchers.

For example, in 2021, the World Bank, in collaboration with the Government Transparency Institute, launched a prototype of a global dashboard that provides access to open data from national electronic procurement systems from 46 countries, as well as open data on World Bank– and Inter-American Development Bank–financed contracts for over 100 countries.¹² Similarly, the Opentender dashboard provides access to tender data from Tenders Electronic Daily (TED), which covers 33 EU jurisdictions, including 28 EU member states, Norway, the EU institutions, Iceland, Switzerland, and Georgia.¹³ The creation and maintenance of these global public goods, and the use of open public procurement data in general, would be simplified by the adoption of common data standards globally, and the Open Contracting Data Standard from the Open Contracting Partnership provides a promising starting point.¹⁴

Some governments are also creating public dashboards using their own public procurement data. For example, an intuitive and simple dashboard prepared by the National Informatics Centre in India and hosted on the Central Public Procurement Portal allows users to get some key performance and compliance indicators on public procurement in India.¹⁵ This dashboard not only allows the government to monitor key procurement trends but also reports these indicators to the public for greater transparency and accountability. The public procurement authority in Ukraine has also designed and published a public dashboard to increase transparency and accountability in public procurement.¹⁶ The COVID-19 crisis prompted more countries to increase transparency and enable public scrutiny of purchases made during the health emergency, such as Brazil, Moldova, Lithuania, and South Africa.¹⁷

SETTING UP DATA INFRASTRUCTURES AND CAPACITY FOR MEASUREMENT ON PROCUREMENT

Centralize Public Procurement Data

To ensure that public procurement data are used effectively for decision-making, it is necessary that data are homogeneously collected and maintained across procuring entities and connected to a centralized platform. This is necessary both for external users and researchers as well as for the national agency or central procurement authority. Public procurement data are often decentralized or housed by different institutions responsible for managing different parts of the procurement process, and this may complicate the process of data harmonization and centralization, especially in countries without an e-GP system and where reporting of procurement activities to a central authority is not mandatory or audited. For example, in 2021, a World Bank team conducted a data collection exercise of paper-based procurement records in St. Lucia, Dominica, St. Vincent and the Grenadines, and Grenada to assess public procurement systems in the four countries. The key constraint on data collection was the decentralization of the information among multiple institutions; ultimately, the data had to be collected by enumerators from different procuring entities and national authorities.

Enabling factors for the centralization of public procurement data include legislation, administrative structure, and data infrastructure. Simple mechanisms like an annual data collection exercise at the central level, in which procuring entities send Excel files to a central authority (which audits a sample for data accuracy), can help slowly transfer local data storage mechanisms to more efficient, centralized data management systems. For example, this was recommended in the case of St. Lucia, Dominica, St. Vincent and the Grenadines, and Grenada, with the additional recommendation to conduct regular audits of the quality and accuracy of the data provided by each procuring entity to the central authority. This step can be a key foundation on which an appetite for data literacy and digitalization can be created among governments. In contrast to data sitting in physical files in different procuring entities, a centralized data collection mechanism can allow for easy access to procurement data even in cases where an e-GP system has not yet been implemented.

Integrate Data from Various Stages of the Public Procurement and Contract Management Cycle

Data integration can be an important step in exploring all the stages of the public procurement and contract management cycle. Data integration can be accomplished through two related steps: (1) matching data from various procurement stages and (2) expanding the availability of data to study procurement more holistically. With respect to the first step, public procurement data typically cover the following stages: tendering process, bidding process, bid evaluation, contract award, and contract signing. To meaningfully use this data, it is necessary that the tenders data, lots data, bids data, and contracts data are consistently organized and can be connected (see figure 12.1).

The second step in data integration is expanding the availability of data to cover the full public procurement and contract management cycle, including parts of the process that are not typically included in procurement data, such as data on public procurement planning and budgeting, tender preparation data, contract execution data (for example, data on subcontracting and payments to vendors), complaints data, and proprietor information and beneficial ownership data.

There is great scope for using these additional data sources for procurement data analytics, and some countries are taking steps in this direction. The development of integrated data systems requires the close engagement and partnership of multiple government institutions that house different parts of the procurement and contract management cycle. For example, as part of the design and development of the monitoring mechanism delivered to the ANAP in Romania (see above), the World Bank was able to add data on complaints registered in public procurement processes to the dashboard by leveraging existing data-sharing agreements between the ANAP and the National Council for Solving Complaints. While the establishment of streamlined data management systems is a necessary technical requirement for a data integration process, the most significant constraints often lie in the administrative and bureaucratic structures that may complicate collaboration and data-sharing agreements between different institutions.

Data Quality and Completeness

Data quality and completeness are crucial determinants of the quality of empirical analysis that can be performed on public procurement data. Common issues in public procurement data are noted across countries, both in the data obtained from open sources as well as in the data obtained from governments. Some of these common issues, which are listed in box 12.4, range from missing data to incorrect or ambiguous data structures that restrict or hinder comprehensive empirical analysis.

Some data quality and completeness issues can be mitigated through relatively simple and practical steps by the government. The e-GP system can include automated data quality checks during data entry by procuring entity officers—for example, checking that the procurement process dates follow a logical order and that the contract amounts are within reasonably expected ranges. Detailed audits of the data entered by procuring entity officers may also be conducted regularly to ensure that the official tender and contract documents reflect the data entered into the system. The central procurement authority can also review the data maintained in the procurement system to assess their completeness, especially in light of the compliance and performance indicators the government is interested in monitoring. Last, implementing a fully transactional system that manages the entire procurement process from start to finish and allows multiple government agencies and ministries to engage with different parts of the procurement process may allow for the ideal data integration environment to holistically analyze the full procurement process and all related parts in public administration.

When planning for the public disclosure of procurement data, the same principles of data quality and completeness apply to ensure data transparency and accessibility. In addition, in this case, it is important that the raw data entered into the system are made public, not only the indicators and measures constructed from the administrative microdata. Observations across several countries also show that open data and good policies for data openness and transparency do not necessarily correlate with data quality

BOX 12.4 Examples of Common Issues with Data Quality and Completeness

- **Missing observations or variables and data errors that pertain to important aspects of the procurement process.** In most countries, electronic government procurement (e-GP) data are not created directly from digitized tenders and contracts but are separately inputted by procuring entity officers. In these cases, the procuring entity officers may still have the option to leave certain data fields blank. This generates gaps in the data and can also indicate strategic behavior by procuring entity officers, who may systematically choose to leave more sensitive data fields blank. Data quality and completeness should be systematically reviewed by a central authority, including for data disclosed to the public.
- **Ambiguity in the level of observation for the data.** Data from different stages of the public procurement cycle (figure 12.1) should be meaningfully connected for analysis through unique identifiers, such as the tender ID or the entity ID. The absence of unique identifiers creates ambiguity in the interpretation of the data and hinders comprehensive empirical analysis. For example, in the case of framework agreements, there can be multiple contracts, buyers, and suppliers under a tendering process, and multiple orders can be associated with the same umbrella contracts. Having a clear and unambiguous data structure is necessary to correctly represent framework agreement processes and enable accurate analysis.
- **Correction of incorrect entries in the e-GP system by entering the entire tendering process again.** This issue is observed in countries where e-GP data are not created directly from digitized tenders and contracts but are separately inputted by procuring entity officers. Possibly because of integrity concerns, some e-GP systems do not allow officers to correct information already entered into the system in the event of data-entry errors. In these cases, the officers' only option is to create a new entry, but the system does not record which entry is correct and which entry is wrong.
- **Poor data integration during transitions from one e-GP system to another.** Throughout the digitalization of public procurement, countries may shift from one e-GP platform to another. For example, Romania transitioned from a platform called SEAP (Sistemul Electronic de Achizitii Publice) to an upgraded platform called SICAP (Sistemului Electronic Colaborativ de Achizitii Publice), and Colombia from a platform called SECOP I to an upgraded platform called SECOP II (Sistema Electrónico para la Contratación Pública). In cases of transition between e-GP systems, it is necessary to ensure that data from both platforms can be integrated and that procuring entity officers cannot enter data for procurement processes in both platforms during the transition.

and completeness. For example, the Open Contracting Data Standard provides guidelines on the effective disclosure of public procurement data to the public, with the ultimate goal of increasing transparency in procurement and allowing analysis of procurement data by a wide range of users. While an increasing number of e-GP systems follow the Open Contracting Data Standard for the public disclosure of procurement data, how well disclosure is implemented largely depends on the quality and completeness of the data made publicly available.

Building Capacity for Statistical Analysis and a Culture of Data-Driven Policy Making

The adoption of e-GP systems has created a great wealth of data, but it is not obvious that their use and impact are currently being maximized by governments. The development of the capacity for statistical analysis and a culture of data-driven decision-making can help maximize the potential of the microdata available through e-GP platforms. This may include the creation or strengthening of a dedicated statistical office within the public procurement authority.

For example, as part of the design and development of the monitoring mechanism delivered to the ANAP in Romania (see above), the entire monitoring mechanism was created in close collaboration with ANAP staff through weekly capacity-building workshops and meetings to discuss the operational workflow of the monitoring mechanism. This close collaboration and cocreation of the interactive dashboard for visualizing key procurement indicators allowed the government to engage with the data-cleaning and visualization process and built an appetite for data analysis. ANAP staff were provided with the necessary skills and knowledge to edit and develop the code that was used to create the interactive dashboard. Engagements like this allow products like an interactive dashboard to be hosted in a data-curious and analytical environment that builds long-term sustainability through the empowerment of its users.

Beyond statistical capacity and data analytics skills, the proactive use of data and evidence to drive policy-making decisions also requires the necessary organizational culture, institutional arrangements, and incentive systems. For example, data and empirical evidence can be used to improve the performance of procuring entities. This requires the necessary skills and tools to exploit the potential of data analytics, but it also depends on other systemic factors, such as whether and how the performance of procuring entities is evaluated, whether there are consequences of performance evaluations, whether procuring entity officers are incentivized to improve their efficiency and effectiveness, and whether procuring entity officers have space to make discretionary decisions or instead are expected to merely execute regulations. These considerations are related to a broader discussion on management practices in public administration and specifically in procuring entities, and the following section provides more detail on how some of these aspects can be studied empirically.

A WHOLE-OF-GOVERNMENT APPROACH: STRATEGIC COMPLEMENTARITIES TO PUBLIC PROCUREMENT DATA

Measuring the Socioeconomic and Environmental Dimensions of Public Procurement

Increasingly, governments consider using public procurement as a strategic tool to sustain the private sector, especially groups of firms that are traditionally underrepresented in public procurement, such as SMEs and women-owned enterprises (WOEs). Similarly, governments are increasingly adopting green public procurement (GPP) strategies, such as green evaluation criteria, green eligibility criteria, or life-cycle approaches to costing (box 12.5).¹⁸

However, there is no clear evidence of the best public procurement strategies and policies to achieve these socioeconomic and environmental outcomes. For example, from a theoretical point of view, it is not clear how to incentivize the participation of SMEs in public procurement effectively and efficiently. While this might be achieved through targeted policies (for example, preference policies or set-aside quotas), these policy tools might be distortionary (Medvedev et al. 2021; OECD 2018) or suffer from poor implementation and compliance. Relying on untargeted policies can be an alternative, but it is perhaps a less impactful approach. Two studies conducted on the same preferential treatment program for small firms in California elucidate these potential trade-offs, with Marion (2007) finding that procurement costs are 3.8 percent higher on auctions using preferential treatment and Krasnokutskaya and Seim (2011) finding that those distortionary effects are not huge in comparison to benefits to firm growth. With limited evidence on the impact and trade-offs of these different policy options, there are no clear guidelines on the best strategies to involve SMEs and other underrepresented groups in public procurement.

As another example, some public procurement laws mandate the application of green criteria for bid evaluation, especially in sectors such as transport (for example, types of vehicle and emissions) and construction (for example, construction materials) (Palmujoki, Parikka-Alhola, and Ekroos 2010), but it is unclear what the direct and indirect cost implications of these requirements are. By design, GPP introduces additional laws and regulations, requirements for firms, and more complex criteria for bid evaluation. Therefore, it is natural that there might be concerns about whether GPP compromises the efficiency of public procurement procedures and reduces the attractiveness of public procurement contracts for firms. Providing robust knowledge on the costs and benefits of GPP will support governments in making informed decisions and might remove some of the concerns that prevent broader adoption.

This focus and strategic approach to public procurement requires that public procurement data be expanded to include the necessary information to measure the socioeconomic and environmental dimensions of public procurement, such as by associating an SME tag with bidders and suppliers or by labeling tenders that follow GPP principles. For example, Nissinen, Parikka-Alhola, and Rita (2009) develop a detailed list of environmental indicators to measure GPP, including indicators on product characteristics, policy attached, level of emission of the company, chemistry, and amount of energy used. In practice, across countries, there has been some progress in tagging SME firms—for example, in Croatia, Romania, and Colombia—but very limited progress in GPP (see box 12.5). This impedes advancing the empirical literature on the effectiveness of different policy alternatives, and it also prevents governments and civil society from monitoring the actual use and implementation of GPP legislation.

BOX 12.5 What We Know about Green Public Procurement

Green public procurement (GPP) is defined by the European Commission (2008) as “a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared with goods, services and works with the same primary function that would otherwise be procured.”

GPP can take different forms, and different measurement options should be considered depending on the GPP approach adopted for each specific tender. A first categorization of GPP approaches is as follows (World Bank 2021b):

- **Contract performance clauses** ensure winning suppliers deliver a contract in an environmentally friendly way and continuously improve their environmental performance throughout the contract duration. Examples of these clauses include the requirement to deliver goods in bulk to reduce packaging, the requirement to optimize delivery schedules, and the requirement to recycle or reuse packaging after delivery.
- **Award criteria** can include optional environmental criteria to encourage and reward bidders that propose solutions with improved environmental performance (for example, a higher percentage of recycled content and functional criteria that allow supplier innovation). This approach requires that procuring entities set weights to evaluate the various dimensions of a proposal, such as environmental criteria and price.
- **Qualification criteria and technical specifications** prescribe core environmental criteria that bidders and/or offers must meet to satisfy the requirements of the tender (for example, minimum recycled content or bans on toxic chemicals).^a For example, supplier-selection criteria aim to ensure that participating bidders have the technical capabilities, ethics, and management processes in place to deliver on the desired environmental outcome. Examples of these criteria are proof of compliance with environmental laws and regulatory standards, the existence of qualified staff with environmental expertise, and environmental certifications.
- **Life-cycle approaches** consider the total cost of ownership (TCO) of a good, service, or work, an estimate that considers not only its purchase price but also the operational and maintenance costs over its entire life cycle. The life-cycle cost (LCC) goes further than the TCO by also taking into account the cost of environmental externalities that can be monetized (for example, greenhouse gas emissions and pollution fees).

Given the speed of innovations in this field, it may be challenging for procuring entities to define appropriate environmental criteria that correspond to current benchmarks and environmental criteria that can be expected of and met by private sector actors. There are various mechanisms that can help procuring entities determine the “environmental friendliness” of a good, service, work, or firm (World Bank 2021b):

(continues on next page)

BOX 12.5 What We Know about Green Public Procurement (*continued*)

- **Ecolabels** are labels of environmental excellence awarded to products and services meeting high environmental standards throughout their life cycle. Ecolabels can be awarded based on third-party certification, supplier claims of environmental conformity, or third-party validation of an environmental product declaration.
- **“Green” product lists** or online databases of preapproved green goods, works, and services can be created by governments and made available to procurers across the government.
- **Framework agreements** can be set up by central procurement authorities to include GPP approaches, making it easier for all procuring entities to purchase green without entering into difficult processes for market analysis, tender design, and bid evaluation.

a. An example of these criteria is detailed by the European Commission on the EU GPP criteria page of its website: https://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm.

Linking Public Procurement Data to Other Dimensions of the Public Sector and Public Administration

Public procurement is multidimensional and critically interconnected with other functions of the public sector and public administration. For example, the participation of small firms in the public procurement market may be influenced by the ease of access to finance or by tax subsidies provided to certain disadvantaged firms. Similarly, the administrative burden of public procurement processes may be influenced by the staffing, training, and resources in the local procuring entities. The incentives of participants in a procurement process may be influenced by several factors. A promising area for advancement in public procurement research would be to collect and integrate data from other parts of the public sector, justice, and tax administration to create novel integrated data sets providing a holistic picture of the procurement function. This would provide governments with comprehensive information to develop innovative and impactful procurement strategies, as well as allow researchers to holistically explore the environment within which procurement is conducted.

Many potential data sets could be used to extend the analysis of public procurement through other dimensions of public administration. One example is linking tax registries and public procurement data. Data on tax filings by firms could be useful to characterize the firms operating in public procurement markets—for example, in terms of size—and the link between public procurement and the growth of firms (Ferraz, Finan, and Szerman 2015), as well as to assess the effectiveness of policies that intend to favor the participation of SMEs in public procurement.

Another potential data set is linking public procurement data with audits data. If properly designed, audits can be an effective tool to disincentivize malpractice in public procurement. However, as demonstrated by Gerardino, Litschig, and Pomeranz (2017), the design and targeting of audits can distort incentives for procurement officers. For example, procurement officers may be less likely to use competitive methods if they expect these procedures will be more likely to be audited due to their complexity, or they may be less likely to comply with regulations that are difficult for auditors to monitor, such as the application of preferential policies for SMEs or the application of green award criteria.¹⁹

Public procurement data can also be complemented with complaints data and judicial data. Box 12.3 discusses the potential for matching public procurement data with judicial data to validate collusion-screening algorithms. Beyond this type of application, there is also space for further research on how performance in public procurement functions is affected by the efficiencies and performance of the judicial sector. Coviello et al. (2018) have demonstrated, in the context of Italy, the implications of inefficient

courts on procurement outcomes, such as longer delays in the delivery of public works, a higher likelihood that contracts are awarded to larger suppliers, and higher shares of payments postponed after delivery. Further studies on the link between public procurement and the justice sector would be necessary to advance our understanding of how these two functions of the state influence each other—for example, whether judicial investigations have an impact on processing and contract execution times, which types of procedures are more likely to result in complaints or investigations, whether the risk of complaints and appeals is a barrier to firm participation, and whether the efficiency of courts has an impact on the propensity of procuring entities to enforce late penalties.

The integration of public procurement into overall public finance management, budgeting, auditing, and service delivery processes has a high potential to lead to better utilization of public resources through better information transmission, standardization, and automation and increased accountability (OECD 2017). Despite this potential, the integration of e-procurement systems into other e-government systems is not yet a common practice. For example, based on a 2016 review of public procurement systems in OECD countries, e-GP systems are most often integrated with business registries (eight countries), tax registries (seven countries), budgeting systems (six countries), and social security databases (six countries) (OECD 2017). Data integration is an area where further work is needed to promote a whole-of-government approach from a data perspective.

Insights on Public Procurement Data from Survey Data

Along with using administrative data on public sector and public procurement, surveys of procuring entity officers and firms provide important context on the environment in which procurement is conducted. Surveys of procuring entity officers can be used to measure procurement-related information otherwise unavailable in the administrative data, such as time for tender preparation, contract execution quality, and firm performance. For example, in an assessment of the public procurement system in Croatia, the World Bank collected survey responses from procuring entity officers on the quality of delivered goods and services by firms and on contract management deadlines, such as the date of delivery and the final payment amount for contracts. These indicators were not available in the publicly available data in Croatia, and this data collection exercise was successful in identifying constraints during the contract management phase.

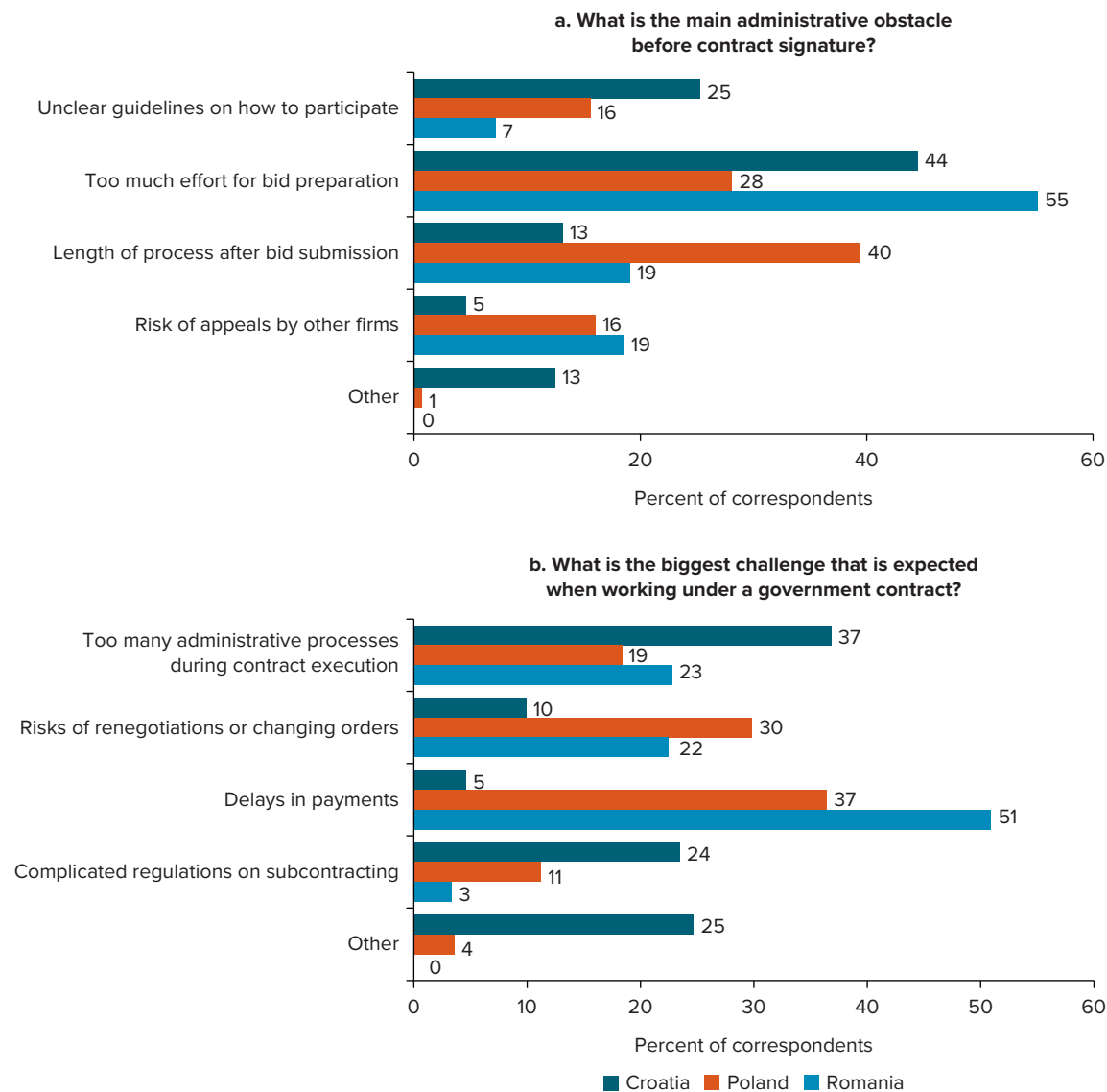
Surveys of procuring entity officers may also help measure the perceptions and behaviors of procuring entity officers with regard to overall organizational management, the administrative burden of conducting and reporting on procurement regulations, human resource management (HRM), roles, and incentives within their teams. For example, the 2021 World Bank report on the use of framework agreements relied on both administrative microdata and survey data.²⁰ Procuring entity officers in India and Ethiopia were surveyed about the perceived administrative burden of using framework agreements relative to other public bidding methods. While quantitative analysis revealed some savings in price through the use of framework agreements, the survey provided more context about the burden officers might feel when implementing different types of procurement methods. Similarly, several studies on GPP have been conducted through surveys to understand the incentives of procuring entity officers to adopt GPP criteria in the award process, as well as to map the difficulties and challenges entities face with GPP regulations at different stages of the procurement process.

In addition to surveying procuring entity officers, reaching out to firms participating in the public contract market can also provide complementary information for understanding public procurement from the perspective of private sector actors. For example, Uyarra et al. (2014) find that for firms in the United Kingdom, the main barriers to entry into the public procurement market are a lack of interaction with procuring organizations, the low competency of civil servants, and poor management systems, and Knack, Biletska, and Kacker (2019) find that firms are more likely to participate in public procurement in countries where public procurement systems are more transparent and complaint systems are more effective. Surveys of firms can also be a useful tool to analyze special groups of firms (for example, SMEs and WOE) in countries where public procurement data do not allow for the identification of bidder and supplier characteristics

and where procurement data cannot be linked to other administrative data, such as firm registries. In 2021, the World Bank designed a procurement module as part of the Enterprise Surveys to better understand the barriers and challenges experienced by firms with respect to public procurement, and they piloted this module in Romania, Poland, and Croatia. The survey data reveal that the main administrative obstacle to participation in Poland is the length of the process between bid submission and contract signature, while in Croatia and Romania, it is the fact that too much effort is required for bid preparation (figure 12.7a). The biggest challenge when working under a government contract is payment delays in Poland and Romania and the number of administrative processes during contract execution in Croatia (figure 12.7b).

Using survey data in public procurement is relevant from a policy perspective in order to complement administrative data measurements, but it is also relevant from a research point of view. HRM practices,

FIGURE 12.7 Obstacles and Challenges to Government Contracts, Croatia, Poland, and Romania, 2021



Source: Original figure for this publication based on microdata from the World Bank Enterprise Surveys Follow-Up on COVID-19 2021, Round 3, for Croatia, Poland, and Romania.

Note: Panel a: Weighted results. Only firms that indicated that administrative procedures before contract signature are an obstacle to attempting to secure a government contract. Panel b: Weighted results. Only firms that indicated that expected challenges during contract execution are an obstacle to attempting to secure a government contract.

attitudes, and motivations in public administration are typically measured through surveys of civil servants. Public procurement can be an ideal area to study the link between these dimensions and outcomes, advancing our understanding of the impact of HRM practices, attitudes, and motivations on performance and compliance.

CONCLUSION

This chapter has provided an overview of how public procurement data can be used for monitoring and evaluating public procurement, as well as for informing reform efforts and defining new policies and strategies in public procurement. It has included a description of various data analytical tools that can be applied to public procurement, an account of typical challenges encountered in public procurement data and potential solutions, and a discussion of recent innovations, such as the development of interactive dashboards.

The chapter has included various lessons for practitioners and governments on using and analyzing public procurement administrative data, including centralizing public procurement data, integrating data from different procurement stages and from data systems related to other government functions, ensuring data quality and completeness, and building capacity for statistical analysis, such as by creating a dedicated statistical unit in the public procurement authority.

The chapter has also highlighted various areas where there is a need for further development and research, specifically in measuring the quality of contract implementation, integrating public procurement data with other administrative microdata or survey data, measuring GPP, and, more generally, generating robust empirical evidence on effective ways to improve the efficiency, integrity, inclusiveness, and sustainability of public procurement. For example, the World Bank's Governance Global Practice and the Development Impact Evaluation (DIME) Governance and Institution Building unit have been collaborating on a research agenda about the link between public procurement and private sector growth, which includes a series about research projects and data innovations, such as connecting public procurement data, payment data, and tax registry data.²¹

NOTES

The chapter is based on academic research and operational experience from several World Bank projects that use data analytical tools in the area of public procurement—for example, in Romania (led by Carmen Calin, procurement specialist), Croatia (led by Antonia Viyachka, procurement specialist), and Bangladesh (led by Ishtiaq Siddique, senior procurement specialist). The chapter greatly benefited from comments and inputs by Carmen Calin (World Bank, procurement specialist), Maria Arnauld Canudo (consultant, Development Impact Evaluation [DIME] Department), Daniel Rogger (senior economist, DIME), and Christian Schuster (professor, University College London). Stephen Shisoka Okiya (consultant, DIME) provided excellent research assistance.

1. A seminal paper by Bandiera, Prat, and Valletti (2009) demonstrates that in Italy, 83 percent of the total estimated waste in public procurement is due to passive waste caused by inefficiencies related to constraints such as lack of skills, lack of incentives, and excessive regulatory burden.
2. For example, with respect to the United Nations Sustainable Development Goals, public procurement can contribute to increasing access to markets for small and medium enterprises (target 9.3), responsible consumption and production through sustainable public procurement (target 12.7), reducing corruption and bribery (target 16.5), developing effective, accountable, and transparent institutions (target 16.6), and ensuring public access to information (target 16.10). More information about the Sustainable Development Goals is available on the United Nations Commission on International Trade Law website at <https://uncitral.un.org/en/about/sdg>.
3. Further details on the data in figure 12.1 and on the level of e-GP adoption across countries can be found in the World Bank's *Doing Business 2020* data under the topic "Contracting with the Government": <https://archive.doingbusiness.org/en/data/exploretopics/contracting-with-the-government>.

4. Requirements from international organizations or international treaties could be another strategy to incentivize governments to open public procurement data and adopt transparent monitoring and reporting mechanisms. For example, EU member states are mandated to monitor and report key procurement indicators under Directives 2014/23/EU, 2014/24/EU, and 2014/25/EU.
5. The literature has pointed to three different strategies for measurement validity (Adcock and Collier 2001): content validity (the measurement captures the full content of the definition), convergent validity (alternative measures of the same corrupt phenomenon are correlated), and construct validity (well-established empirical relationships are confirmed by the measurement).
6. As noted above, EU member states are mandated to monitor and report key procurement indicators under Directives 2014/23/EU, 2014/24/EU and 2014/25/EU.
7. The PPO website is available at <https://www.uzp.gov.pl/>.
8. The Public Procurement Agency in Bulgaria, the PPO in Poland, the Office for Public Procurement in the Slovak Republic, and the National Agency for Public Procurement (ANAP) in Romania are examples of institutions that conduct audits of compliance and performance monitoring.
9. Deliverable under the World Bank project Framework Agreements for Development Impact: Lessons from Selected Countries for Global Adoption (P173392).
10. Report under the project Impact Evaluation of e-Procurement In Bangladesh (P156394).
11. The role of civil society in monitoring public procurement is widely recognized. For example, within the EU project Integrity Pacts—Civil Control Mechanism for Safeguarding EU Funds, “integrity pacts” are established between a contracting authority and economic operators bidding for public contracts, stipulating that parties will abstain from corrupt practices and conduct a transparent procurement process, and a separate contract with a civil society organization entrusts it with the role of monitoring that all parties comply with their commitments. See the Transparency International website at <https://www.transparency.org/en/projects/integritypacts>.
12. More information about the Government Transparency Institute is available on its website, <http://www.govtransparency.eu/>. The dashboard prototype is available here: <https://www.procurementintegrity.org/>.
13. The Opentender dashboard is available here: <https://opentender.eu/start>.
14. For more information about the Open Contracting Data Standard, see the project website at <https://standard.open-contracting.org/latest/en/>.
15. The India dashboard is available here: <https://eprocure.gov.in/eprocdashboard/KPI.html>.
16. The Ukraine dashboard is available here: <https://bi.prozorro.org/hub/stream/aaec8d41-5201-43ab-809f-3063750dfafd>.
17. On Brazil, see CGU (2020). Moldova’s COVID-19 procurement website can be viewed here: <https://www.tender.health/>. Lithuania’s procurement webpage can be viewed on the Public Procurement Office website at <https://vpt.lrv.lt/kovai-su-covid-19-sudarytos-sutartys>. South Africa’s COVID-19 procurement dashboard can be viewed on the National Treasury website at <http://ocpo.treasury.gov.za/COVID19/Pages/Reporting-Dashboard-Covid.aspx>.
18. Green evaluation criteria can be included in different levels of procurement and in the bidding process by setting technical specifications, specific qualifications, contract requirements, selection criteria, and/or award criteria (Testa et al. 2012).
19. As an example of the former, Gerardino, Litschig, and Pomeranz (2017) investigate the impact of the audit selection process in Chile, using public procurement data from 2011 to 2012. Under the existing audit protocol in that period, open auctions underwent more than twice as many checks as direct contracting. The authors find that, given this protocol, procurement officers shifted toward direct contracting methods and reduced the use of open auctions, especially in procuring entities that experienced more audits and therefore had more opportunities to learn about this targeting design. As an example of the latter, in some countries, procuring entities are required to reserve a given quote of their spending for SMEs, but it is challenging for auditors to monitor compliance with this requirement if public procurement data do not include a tag to identify contracts awarded to SMEs.
20. Deliverable under the World Bank project Framework Agreements for Development Impact: Lessons from Selected Countries for Global Adoption (P173392).
21. See the World Bank project Public Procurement and Firm Behavior (P177551).

REFERENCES

- Adam, Isabelle, and Mihály Fazekas. 2019. “Big Data Analytics as a Tool for Auditors to Identify and Prevent Fraud and Corruption in Public Procurement.” *European Court of Auditors Journal* 2: 172–80. <https://medium.com/ecajournal/big-data-analytics-as-a-tool-for-auditors-to-identify-and-prevent-fraud-and-corruption-in-public-68184529334c>.
- Adcock, Robert, and David Collier. 2001. “Measurement Validity: A Shared Standard for Qualitative and Quantitative Research.” *American Political Science Review* 95 (3): 529–46. <https://doi.org/10.1017/S0003055401003100>.

- Bandiera, Oriana, Andrea Prat, and Tommaso Valletti. 2009. "Active and Passive Waste in Government Spending: Evidence from a Policy Experiment." *American Economic Review* 99 (4): 1278–308. <https://doi.org/10.1257/aer.99.4.1278>.
- Best, Michael Carlos, Jonas Hjort, and David Szakonyi. 2019. "Individuals and Organizations as Sources of State Effectiveness." NBER Working Paper 23350, National Bureau of Economic Research, Cambridge, MA. <https://doi.org/10.3386/w23350>.
- Bosio, Erica, Simeon Djankov, Edward L. Glaeser, and Andrei Shleifer. 2022. "Public Procurement in Law and Practice." *American Economic Review* 112 (4): 1091–117. <https://doi.org/10.1257/aer.20200738>.
- CGU (Controladoria-Geral da União). 2020. "CGU lança painel para dar transparência a contratações relacionadas à Covid-19." Comptroller General of Brazil, March 7, 2020. <https://www.gov.br/cgu/pt-br/assuntos/noticias/2020/07/cgu-lanca-painel-para-dar-transparencia-a-contratacoes-relacionadas-a-covid-19>.
- Conley, Timothy G., and Francesco Decarolis. 2016. "Detecting Bidders Groups in Collusive Auctions." *American Economic Journal: Microeconomics* 8 (2): 1–38. <https://doi.org/10.1257/mic.20130254>.
- Coviello, Decio, Luigi Moretti, Giancarlo Spagnolo, and Paola Valbonesi. 2018. "Court Efficiency and Procurement Performance." *The Scandinavian Journal of Economics* 120 (3): 826–58. <https://doi.org/10.1111/sjoe.12225>.
- Decarolis, Francesco, Raymond Fisman, Paolo Pinotti, and Silvia Vannutelli. 2020. "Rules, Discretion, and Corruption in Procurement: Evidence from Italian Government Contracting." NBER Working Paper 28209, National Bureau of Economic Research, Cambridge, MA. <https://doi.org/10.3386/w28209>.
- Decarolis, Francesco, and Cristina Giorgiantonio. 2022. "Corruption Red Flags in Public Procurement: New Evidence from Italian Calls for Tenders." *EPJ Data Science* 11: 16. <https://doi.org/10.1140/epjds/s13688-022-00325-x>.
- European Commission. 2008. *Public Procurement for a Better Environment*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions, COM(2008) 400. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF>.
- Fazekas, Mihály, Luciana Cingolani, and Bence Tóth. 2018. "Innovations in Objectively Measuring Corruption in Public Procurement." Chap. 7 in *Governance Indicators: Approaches, Progress, Promise*, edited by Helmut K. Anheier, Matthias Haber, and Mark A. Kayser. Oxford: Oxford University Press. <https://doi.org/10.1093/oso/9780198817062.003.0007>.
- Fazekas, Mihály, and Gábor Kocsis. 2020. "Uncovering High-Level Corruption: Cross-National Corruption Proxies Using Public Procurement Data." *British Journal of Political Science* 50 (1): 155–64. <https://doi.org/10.1017/S0007123417000461>.
- Fazekas, Mihály, Salvatore Sberna, and Alberto Vannucci. 2021. "The Extra-Legal Governance of Corruption: Tracing the Organization of Corruption in Public Procurement." *Governance: An International Journal of Policy, Administration, and Institutions* 35 (4): 1139–61. <https://doi.org/10.1111/gove.12648>.
- Fazekas, Mihály, and Bence Tóth. 2018. "The Extent and Cost of Corruption in Transport Infrastructure: New Evidence from Europe." *Transportation Research Part A: Policy and Practice* 113: 35–54. <https://doi.org/10.1016/j.tra.2018.03.021>.
- Fazekas, Mihály, Gavin Ugale, and Angelina Zhao. 2019. *Analytics for Integrity. Data-Driven Approaches for Enhancing Corruption and Fraud Risk Assessments*. Paris: OECD Publishing. <https://www.oecd.org/gov/ethics/analytics-for-integrity.pdf>.
- Ferraz, Claudio, Frederico Finan, and Dimitri Sberman. 2015. "Procuring Firm Growth: The Effects of Government Purchases on Firm Dynamics." NBER Working Paper 21219, National Bureau of Economic Research, Cambridge, MA. <https://doi.org/10.3386/w21219>.
- Gerardino, Maria Paula, Stephan Litschig, and Dina Pomeranz. 2017. "Distortion by Audit: Evidence from Public Procurement." NBER Working Paper 23978, National Bureau of Economic Research, Cambridge, MA. Revised August 2022. <https://doi.org/10.3386/w23978>.
- Hassan, Mirza. 2017. "Citizen Engagement during Public Procurement Implementation in Bangladesh." South Asia Procurement Innovation Awards 2016, World Bank, Washington, DC. <https://wbnpf.procurementinet.org/featured/citizen-engagement-during-public-procurement-implementation-bangladesh>.
- Huber, Martin, and David Imhof. 2019. "Machine Learning with Screens for Detecting Bid-Rigging Cartels." *International Journal of Industrial Organization* 65: 277–301. <https://doi.org/10.1016/j.ijindorg.2019.04.002>.
- Knack, Stephen, Nataliya Biletska, and Kanishka Kacker. 2019. "Deterring Kickbacks and Encouraging Entry in Public Procurement Markets: Evidence from Firm Surveys in 90 Developing Countries." *World Bank Economic Review* 33 (2): 287–309. <http://hdl.handle.net/10986/34863>.
- Krasnokutskaya, Elena, and Katja Seim. 2011. "Bid Preference Programs and Participation in Highway Procurement Auctions." *American Economic Review* 101 (6): 2653–86. <https://doi.org/10.1257/aer.101.6.2653>.
- Marion, Justin. 2007. "Are Bid Preferences Benign? The Effect of Small Business Subsidies in Highway Procurement Auctions." *Journal of Public Economics* 91 (7–8): 1591–624. <https://doi.org/10.1016/j.jpubeco.2006.12.005>.
- Medvedev, Denis, Ramin N. Aliyev, Miriam Bruhn, Paulo Guilherme Correa, Rodrigo Javier Garcia Ayala, Justin Piers William Hill, Subika Farazi, Jose Ernesto Lopez Cordova, Caio Piza, Alena Sakhonchik, and Morten Seja. 2021. *Strengthening World Bank SME-Support Interventions: Operational Guidance Document*. World Bank Report. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/183521617692963003/Strengthening-World-Bank-SME-Support-Interventions-Operational-Guidance-Document>.

- Mungiu-Pippidi, Alina, and Mihály Fazekas. 2020. "How to Define and Measure Corruption." In *A Research Agenda for Studies of Corruption*, edited by Alina Mungiu-Pippidi and Paul M. Heywood, 7–26. Cheltenham, UK: Edward Elgar. <https://doi.org/10.4337/9781789905007.00008>.
- Nissinen, Ari, Katriina Parikka-Alhola, and Hannu Rita. 2009. "Environmental Criteria in the Public Purchases above the EU Threshold Values by Three Nordic Countries: 2003 and 2005." *Ecological Economics* 68 (6): 1838–49. <https://doi.org/10.1016/j.ecolecon.2008.12.005>.
- OECD (Organisation for Economic Co-operation and Development). 2013. "Ex Officio Cartel Investigations and the Use of Screens to Detect Cartels." Competition Policy Roundtables DAF/COMP(2013)27, Competition Committee, Directorate for Financial and Enterprise Affairs, OECD, Paris. <https://www.oecd.org/daf/competition/exofficio-cartel-investigation-2013.pdf>.
- OECD (Organisation for Economic Co-operation and Development). 2017. *Government at a Glance 2017*. Paris: OECD Publishing. https://doi.org/10.1787/gov_glance-2017-en.
- OECD (Organisation for Economic Co-operation and Development). 2018. *SMEs in Public Procurement: Practices and Strategies for Shared Benefits*. OECD Public Governance Reviews. Paris: OECD Publishing. <https://doi.org/10.1787/9789264307476-en>.
- OECD (Organisation for Economic Co-operation and Development). 2021. *Government at a Glance 2021*. Paris: OECD Publishing. <https://doi.org/10.1787/1c258f55-en>.
- OECD and SIGMA (Support for Improvement in Governance and Management). 2019. *Methodological Framework of the Principles of Public Administration*. Paris: OECD Publishing. <https://www.sigmaweb.org/publications/Methodological-Framework-for-the-Principles-of-Public-Administration-May-2019.pdf>.
- Olken, Benjamin A. 2007. "Monitoring Corruption: Evidence from a Field Experiment in Indonesia." *Journal of Political Economy* 115 (2): 200–49. <https://doi.org/10.1086/517935>.
- Palmujoki, Antti, Katriina Parikka-Alhola, and Ari Ekroos. 2010. "Green Public Procurement: Analysis on the Use of Environmental Criteria in Contracts." *Review of European Community & International Environmental Law* 19 (2): 250–62. <https://doi.org/10.1111/j.1467-9388.2010.00681.x>.
- Singer, Marcos, Garo Konstantinidis, Eduardo Roubik, and Eduardo Beffermann. 2009. "Does e-Procurement Save the State Money?" *Journal of Public Procurement* 9 (1): 58–78. <https://doi.org/10.1108/JOPP-09-01-2009-B002>.
- Testa, Francesco, Fabio Iraldo, Marco Frey, and Tiberio Daddi. 2012. "What Factors Influence the Uptake of GPP (Green Public Procurement) Practices? New Evidence from an Italian Survey." *Ecological Economics* 82: 88–96. <https://doi.org/10.1016/j.ecolecon.2012.07.011>.
- Titl, Vitezslav, and Benny Geys. 2019. "Political Donations and the Allocation of Public Procurement Contracts." *European Economic Review* 111: 443–58. <https://doi.org/10.1016/j.euroecorev.2018.11.004>.
- Turkewitz, Joel, Mihály Fazekas, and Zafrul Islam. 2020. "Case Study 2: e-Procurement Reform in Bangladesh." In *Enhancing Government Effectiveness and Transparency: The Fight against Corruption*, edited by Rajni Bajpai and C. Bernard Myers, 34–39. World Bank Global Report. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/235541600116631094/Enhancing-Government-Effectiveness-and-Transparency-The-Fight-Against-Corruption>.
- Uyarra, Elvira, Jakob Edler, Javier Garcia-Estevéz, Luke Georghiou, and Jillian Yeow. 2014. "Barriers to Innovation through Public Procurement: A Supplier Perspective." *Technovation* 34 (10): 631–45. <https://doi.org/10.1016/j.technovation.2014.04.003>.
- Wachs, Johannes, Mihály Fazekas, and János Kertész. 2021. "Corruption Risk in Contracting Markets: A Network Science Perspective." *International Journal of Data Science and Analytics* 12: 45–60. <https://doi.org/10.1007/s41060-019-00204-1>.
- World Bank. 2017. *Pakistan—Punjab Land Records Management and Information Systems Project*. ICR00003719. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/632241498842804246/Pakistan-Land-Records-Management-and-Information-Systems-Project>.
- World Bank. 2019. *Romania—Reimbursable Advisory Services Agreement on Assessment of the Public Procurement System and Further Support to the Implementation of the Public Procurement Strategy: Output 4: Final Version of the Web-Based Guide*. P169141. Washington, DC: World Bank. <https://pubdocs.worldbank.org/en/412981574427978384/RO-TOR-Procurement-SME-2019.pdf>.
- World Bank. 2020. *Assessment of Bangladesh Public Procurement System*. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/33882>.
- World Bank. 2021a. *Econometric Analysis of Framework Agreements in Brazil and Colombia*. Washington, DC: World Bank. <https://doi.org/10.1596/36059>.
- World Bank. 2021b. "Green Public Procurement: An Overview of Green Reforms in Country Procurement Systems." Climate Governance Papers, World Bank, Washington, DC. <http://hdl.handle.net/10986/36508>.