E-procurement and firm corruption to secure public contracts: The moderating role of governance institutions and supranational support

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Abstract

This paper investigates the effects of e-procurement on firm corruption to secure public contracts, highlighting the moderating roles of the quality of governance institutions and supranational support in that relationship. Taking transaction cost economics as our theoretical lens, and building on a sample of 8,373 firms in 72 countries from 2008 to 2019, we find that the adoption of an e-procurement system in fact reduces firm corruption. However, this effect is only unveiled once one accounts in the analysis for the quality of country-level governance institutions, which also makes the relationship stronger. We also find an e-procurement system only to effectively address firm corruption when it benefits from supranational support. The study contributes to the ongoing ac-ademic debate on the impact of digitalization on corruption.

Keywords: Corruption; E-procurement; Governance institutions; Supranational support; Transaction costs; Digitalization

1. Introduction

Corruption, defined as "the abuse of entrusted power for private gain" (Cuervo-Cazurra, 2016, p. 36), is costly for society. It leads to the misallocation of public resources and underinvestment in public infrastructures and services (Mauro, 1995). It raises costs for firms (Doh, Rodriguez, Uhlenbruck, Collins, & Eden, 2003), discourages private investment (Shleifer & Vishny, 1993), deters market entry (OECD, 2016), and discriminates in favor of less productive firms (Mironov & Zhuravskaya, 2016). Corruption is detrimental to Foreign Direct Investment (FDI), due to the additional local costs of doing business (OECD, 2016; Wei, 2000), and the risks for Multinational Enterprises (MNE) resulting from uncertainties in foreign markets (Sartor & Beamish, 2018) as well as the pressures imposed by anti-corruption laws following the 1997 OECD Anti-bribery Convention (Cuervo-Cazurra, 2008).

Public procurement is typically an interaction between bureaucrats and firm managers, and is frequently associated with bureaucratic corruption (Prasad & Shivarajan, 2015). Bureaucratic (or petty) corruption is the "everyday abuse of entrusted power by public officials in their interactions with ordinary citizens" (Transparency International. (2009), 2009, p. 33), and it typically involves low- to mid-level civil servants.[1] Public procurement will be integral to any meaningful attempt to curb corruption on a large scale (Rose-Ackerman, 1999), as it is the governmental activity that is the most vulnerable to bureaucratic corruption (OECD, 2016; Ware, Moss, Campos, & Noone, 2007; World Bank. (2016), 2016), and as bureaucratic corruption is the most widespread form of corruption worldwide (Jain, 2001), especially in developing and transition economies (Chêne, 2019). Public procurement is a main channel of public spending for the acquisition of goods and services, and is thus an important market for companies. On average, it amounts to 29% and 50% of government budgets, respectively, in high-income and developing countries (World Bank. (2016), 2016), which is a significant share of Gross Domestic Product (GDP) especially in the latter category of countries (Ghossein, Islam, & Saliola, 2018; Knack, Biletska, & Kacker, 2017). Transparency International. (2006) (2006) estimates that in the early 2000 s, about USD 400 billion of public procurement budgets were lost worldwide to corruption every year. A study across five sectors in eight European Union member states, estimated about 13% of the budgets involved in public procurement to be lost due to corruption (PwC, 2013). Alongside the significant amounts of money embezzled, corruption in public procurement induces the underprovision and decreased quality of public goods and services, and a rise in government costs by about 20–25% (Transparency International.

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[1] [1] Another form of corruption is political corruption, which tends to be more confidential as it rests on large-scale transactions involving large firms and political and administrative elites who manipulate policies and institutions for personal enrichment (Treisman, 2009).

(2006), 2006). In Asian countries, corruption may lead public authorities to bear a 20–100% surcharge on the normal price of procured goods and services (ADB/OECD, 2008). These additional costs also fall on firms when they have to make informal payments in order to secure public contracts. A survey of 4,223 firms across the Russian Federation revealed that among those that declared bidding for a public contract, 23% mentioned the necessity to make informal payments estimated to an average of 15% of the contract value (Kisunko, Knack, Islam, & Ponamariov, 2013).

Procurement reforms are essential in the fight against corruption (Rose-Ackerman, 1999) and, for more than two decades, the digitalization of public procurement systems has been advocated and implemented for that purpose (OECD, 2016; Schapper, 2008; Seong & Lee, 2004; Ware et al., 2007). Electronic procurement (e-procurement) refers to the integration of digital technologies throughout the procurement process and the replacement or redesign of paper-based procedures (OECD, 2019). These include purchase requests, authorization, bid processing and selection, ordering, delivery and payment between purchasers and suppliers (Khorana, Ferguson-Boucher, & Kerr, 2015; PwC, 2013; Seong & Lee, 2004). E-procurement is expected to improve government efficiency and access to information, reduce administrative and transaction costs, enhance competition (OECD, 2019; Ware et al., 2007), and help to better control corruption in public procurement, through higher transparency, enhanced integrity and accountability, reduced face-to-face interactions, and lower discretionary power of civil servants (OECD, 2016; Schapper, 2008). As firms also pay bribes in order to avoid or mitigate the information, administrative and transaction costs during public procurement procedures (Knack et al., 2017), e-procurement is likely to reduce corruption through its lowering effect on these costs. For example, curbing corruption had been South Korea's main objective when implementing an e-procurement system at the end of the 1990s (Seong & Lee, 2004; Ware et al., 2007). This initiative, considered as a success (OECD, 2005), is frequently used, along with a few other country examples, to advocate the potential of e-procurement in controlling firm corruption (Heeks, 2005; OECD, 2005; Seong & Lee, 2004). However, systematic cross-country studies into this relationship are still scarce (Kochanova, Hasnain, & Larson, 2020; Schapper, 2008), and the few recent exceptions offer inconclusive results (Ghossein et al., 2018; Kochanova et al., 2020).

On the one hand, Ghossein et al. (2018) found that firms are less likely to pay bribes in order to secure government contracts in economies with good-quality public procurement systems (e.g., including an online bid submission system). On the other hand, Kochanova et al. (2020) observed that the adoption of an e-procurement system had no effect on the likelihood that firms bribe to secure a government contract. At a more general level, studies into the effect of e-government adoption on corruption also provide mixed and inconclusive evidence. Some have found that e-government reduces country-level corruption (Andersen, 2009; Elbahnasawy, 2014), whereas others have explained that the digitalization of administrative procedures can even open up new avenues for corruption (Heeks, 2002), which has indeed been observed in several developing countries (Schopf, 2019).

The more general literature on the effects of e-government on corruption is also characterized by inconclusive results, caused by different viewpoints regarding the mechanisms that underlie the relationship (Khan, Krishnan, & Dhir, 2021). Indeed, studies put forward both negative as well as positive effects of the digitalization of government procedures on corruption (Addo & Senyo, 2020). These conflicting views and findings have both theoretical and empirical roots. Most studies lack a theoretical understanding of the underlying mechanisms, as they do not use any theory or conceptual framework in order to analyze the relationship between e-government procedures and corruption, or to formulate hypotheses (Khan et al., 2021). In addition, these studies fail to acknowledge that contextual factors are likely to influence the relationship (Addo & Senyo, 2020) and that e-government on its own cannot effectively address corruption (Kim, 2014; Rubasundram & Rasiah, 2019. Previous research, informed by country-level perspectives focusing on different East Asian economies, has argued for the existence of high-quality governance institutions to be a necessary condition for effective e-procurement to be effective in curbing corruption (Meagher, 2005; Schopf, 2019). Following this view, an e-procurement system would then also require to be implemented together with a set of necessary resources that can only be gathered through supranational support. These resources can encompass human capital, such as digital capabilities and experience with e-procurement design and use, IT technologies and infrastructures, or financings as well as legitimacy of the overall system (e.g., on the basis of external verification) (Heeks, 2005; Lewis-Faupel, Neggers, Olken, & Pande, 2016; Schapper, 2008; World Bank. (2016), 2016). This is consistent with the complementary resource theory, which posits that for an innovation or a technology to fully deliver on its promises within an organization (here the adoption of an e-procurement system within the public sector or a given country), the latter must gather the necessary capabilities and resources (Teece, 1986). It is also consistent with the notion of institutional complementarity, where the effectiveness of an institution, here an e-procurement system, is contingent upon other institutions (Hall & Soskice, 2001). These resources, capabilities, and institutions are contextual factors that are likely to moderate the relationship between e-government and corruption. By failing to account for them within an adequate theory-driven analysis, studies have fallen short of understanding and establishing how e-government and e-procurement affect corruption (Khan et al., 2021).

An exception is the research by Prasad and Shivarajan (2015), who envision the provision of public services to the firm as a bureaucrat-manager interaction, and then analyze the relationship between e-government and corruption through the lens of Transaction Costs Economics (TCE) (Husted, 1994; Williamson, 1985). This theoretical perspective fits perfectly the case of public procurement. According to this view, transaction costs increase since bureaucrats' opportunistic behavior is enhanced,in turn leading managers to pay bribes in order to secure public services (Prasad & Shivarajan, 2015). E-procurement is likely to impact bureaucratic corruption through its effects on informational and behavioral uncertainties, and on asset specificity in the bureaucrat-manager relation.

We therefore aim to address the following research questions: (1) what is the impact of e-procurement systems on levels of firm corruption to secure public contracts? And (2) do the quality of country-level governance institutions and supranational support moderate the previous relationship? In order to answer our research questions, we take a TCE perspective and analyze a sample of 8,373 firms in 72 countries from 2008 to 2019, finding robust empirical support for our hypotheses.

In responding to our research questions, our paper makes the following contributions. First, and contrary to previous studies, we propose a theory-driven analysis, based on the TCE perspective, of the effect of e-procurement on corruption. In addition, we account for contextual factors that are likely to moderate the relationship. By doing so, we address two theoretical research gaps in the literature (Addo & Senyo, 2020; Khan et al., 2021). We argue that an e-procurement system is negatively associated with firm corruption to secure public contracts because it represents an efficient tool to control bureaucratic corruption, through its effects on transparency, accountability, face-to-face interactions and government officials' discretionary power, and thereby on informational and behavioral uncertainties, and asset specificity in the bureaucrat-manager relation (Prasad & Shivarajan, 2015). We also argue that the "simple adoption" of an e-procurement system, as an indicator, cannot alone reveal its effect on firm corruption, as one also needs to account for the moderating effects of the quality of governance institutions and supranational support in ensuring an enabling environment as well as the proper functioning of the e-procurement system.

Second, we contribute to the streams of literature centered on corruption, digitalization, and public procurement by providing empirical evidence for e-procurement systems to increase the risks and transaction

costs of corruption, thereby reducing the amount of bribes needed to secure public contracts, and thus clarifying the current debate on this effect (Ghossein et al., 2018; Kochanova et al., 2020). We show that the moderating effects of the quality of governance institutions and supranational support are significant and permit to unveil the real effect of e-procurement system adoption on firm corruption. This offers implications, first for policy makers, showing that an e-procurement system can no be self-sufficient in addressing corruption. It must come with necessary institutional features ensuring governance effectiveness, and accompanying measures that raise actors' capabilities. Second, this is likely to send valuable signals to MNEs willing to develop business in developing countries, and concerned with the risk of corruption in government contracts.

The remainder of this article is structured as follows: In the next section, we review the literature on corruption and e-procurement, and develop our hypotheses in the frame of TCE. Next, in the third section we describe the sample, the dependent, the independent, the moderating, and the control variables. In the fourth section, we present the main results of our analysis. Finally, in the fifth section we discuss the main conclusions, limitations, and possible avenues for future research.

2. Literature review and hypotheses

Corruption flourishes where institutions are of poor quality (Svensson, 2003). This is because poorly designed, or poorly implemented, institutions influence a society's incentive system and hence shape individuals' behaviors (North, 1990), leading them to engage in corrupt activities (Baumol, 1990). Corruption adds directly to firms' costs through the payment of bribes (Kaufmann, 1997), and also indirectly through the induced uncertainty (Wei, 1997) which is a major source of transaction costs (Williamson, 1985). Poor quality institutions that materialize into information asymmetry and long, complex, and excessive administrative procedures (i.e., red tape) are costly for firms. In the context of the provision of public goods and services, including procurement procedures, firms may pay bribes in order to avoid excessive transaction costs, whereas a reduction in these transaction costs reduces the amount of a firm's kickbacks (Knack et al., 2017; Prasad & Shivarajan, 2015). Corruption has been studied from multiple theoretical perspectives, namely agency theory, TCE, the resource-based view, resource dependence, and neo-institutional theory (Cuervo-Cazurra, 2016). While we acknowledge the relevance and applicability of all of them, in this paper we focus on the transaction cost implications on firm corruption associated with the implementation of a country-level e-procurement system.

Public procurement is intrinsically vulnerable to corruption, due to the complexity of the process, the close interactions between public officials and businesses, and the financial interests at stake (OECD, 2016; Ware et al., 2007; World Bank. (2016), 2016). Indeed, the high-value transactions motivate a fierce competition between firms, which is further exacerbated when these public contracts are vital for firms, for example in countries where public procurement contracts amount to a large share of the GDP. Bureaucratic corruption is typically perpetrated in public procurement schemes through a bribe, or a kickback paid by the winner of the bid, and proportional to the contract value and the high transaction costs in the bureaucrat-manager interaction (Knack et al., 2017).

Bureaucratic corruption flourishes with the discretionary power of civil servants, if they can for instance arbitrarily modify the procurement process, withhold information selectively to bias the outcome, or simply reject non-favored bidders in order to elicit bribes (Lewis-Faupel et al., 2016; Schapper, 2008). Given the concealing characteristics of corruption, this discretionary power is more likely to be exercised in a context of poor-quality institutions, inducing lacks of transparency and accountability (Rose-Ackerman, 1999), if for example public authorities have no obligation to publish the results of the bidding process (Ghossein et al., 2018).

One main purpose of e-procurement is to address these institutional failures in order to abate bureaucratic corruption. The digitalization of the procurement process permits better direct access to information by businesses and other stakeholders, including civil society, and this raises transparency (Schapper, 2008). More specifically, it facilitates monitoring and detection of irregularities (Fleming, Zyglidopoulos, Boura, & Lioukas, 2022), and a better enforcement of accountability and laws. A more transparent scheme also encourages participation of a higher number of firms in the bidding process, thus reducing the possibility of collusion as a fertile ground for corruption (OECD, 2016; Ware et al., 2007). Technologies that automate, standardize and regularize procedures decrease face-to-face interaction and reduce civil servants' discretionary power and, hence, their ability to rig the bidding process and extort bribes (Schapper, 2008; Seong & Lee, 2004).

Public procurement is a transaction between the manager of a firm and a bureaucrat, for the provision of a public service, and that may lead the former to pay bribes or grant favors to the latter. This is an example of bureaucratic corruption that can be analyzed as a transaction, through the lens of TCE (Husted, 1994; Williamson, 1985). According to TCE, transaction costs originate from two features of the transaction, uncertainty and asset specificity, which favor bureaucrats' opportunistic behavior and lead managers to pay bribes in order to get the public services they are entitled to. First, manager-bureaucrat transactions are subject to two types of uncertainty, behavioral and informational (Prasad & Shivarajan, 2015). Behavioral uncertainty is induced by civil servants' opportunistic behavior, exacerbated by the absence of guarantees that the government official will fulfill his or her side of the transaction once the bribe has been paid, or by the possibility that another bribe will be requested by this or another official (Rodriguez, Uhlenbruck, & Eden, 2005). Informational uncertainty originates from managers' difficulty to obtain all the necessary information on public procurement procedures. This is because the information is ambiguous, it is missing, or it is systematically manipulated and distorted by corrupt bureaucrats (Oldenburg, 1987), leading managers to pay bribes in order to get access to the information, and further encouraging bureaucrats' opportunistic behavior. By increasing the transparency of decision-making, and improving access to all the relevant information on public procurement procedures, an e-procurement system has the potential to reduce informational uncertainty, managers' payments of bribes, and bureaucrats' possibilities to act opportunistically.

Furthermore, TCE also posits that the manager-bureaucrat transaction is characterized by asset specificity (Husted, 1994; Williamson, 1985), as the provision of public goods is, by law, the specific task of civil servants. In the case of public procurement, the specific assets are services such as the selection of winners, the allocation of funds, the diffusion of the relevant information throughout the procedure, or the registration of paperwork. This asset specificity generates a relationship of dependence between the manager and the bureaucrat who can use it to act opportunistically by asking bribes in exchange for his or her work (Husted, 1994). By removing most or all face-to-face interactions between the manager and the bureaucrat in charge of the public procurement process, an e-procurement system mitigates the asset specificity feature and its effects in terms of bribe extortion. This leads us to hypothesize:

Hypothesis 1. A country-level e-procurement system reduces firm corruption to secure public contracts.

Most countries have now implemented e-government procedures (Kochanova et al., 2020), and the World Bank. (2017) (2017) reveals that out of 180 countries surveyed, only 26 had not yet adopted an e-procurement system. However, these figures hide disparities and e-government initiatives are not necessarily and automatically successful but have frequently been partial or total failures (Heeks, 2005). Country-level e-procurement systems differ in terms of their levels of development, sophistication and performance (Schapper, 2008; World Bank. (2016), 2016). In a survey of 77 national e-procurement schemes, the

World Bank. (2016) (2016) observes that most of them exhibit at least some failures with regard to transparency, access to information, or sector coverage of the electronic bidding process.

Likewise, e-procurement systems have been implemented in vastly different country contexts which, in turn, may limit their effectiveness in alleviating corruption, based on e.g., the lack of technology, infrastructures and human capital, or inappropriate institutions (Heeks, 2005; OECD, 2019; Schapper, 2008; World Bank. (2016), 2016).[2] "Creating an anti-corruption system is one thing and changing corrupt behaviors of public officials and citizens is another" (Kim, 2014, p. 386).

Hence, e-procurement systems cannot be viewed in isolation, but form part of a wider system of institutional arrangements. The literature on National Business Systems (NBS) has explored how country-level institutional arrangements shape economic organization and behavior in a given context (Ioannou & Serafeim, 2012; Matten & Moon, 2008; Whitley, 1999). A network of formal and informal institutions linked to a country's political system, its financial system, its education and labor system as well as its cultural system will then determine how economic organization and behavior are conducted (Whitley, 1999). Within this literature, Hall & Soskice (2001) introduce the notion of institutional complementarity, where the efficacy of one institution (such as an e-procurement system) is influenced by the efficacy of related institutions. Along these lines, e-procurement and e-government are parts of wider country-level institutional configurations. This wider governance context will then, in turn, influence the degree to which e-procurement and e-government are able to fulfil their intended purposes.

For example, anti-corruption reforms in poorly governed countries have generally been judged ineffective, if not harmful (Meagher, 2005). Such reforms can deliver their promise only if they are accompanied by effective governance institutions. This means for instance that elected policymakers design and implement laws independently from the pressure of special minority interests. There needs to be transparency in political and bureaucratic decisions, and integrity is further ensured through independent audit systems (Schopf, 2019). In addition, there is a need for anti-corruption laws that are implemented, and enforced by agencies that are accountable, but independent from the executive power (Fan, Kuper, Choi, & Choi, 2021; Heilbrunn, 2004), so that emerging corruption cases in public procurement are prosecuted. Finally, there need to be provisions for whistleblower protection (Kim, 2014), and a reduction of the excessive administrative procedures and controls that grant discretionary power to civil servants, in particular for the selection of procurement winners (Schopf, 2019).

These types of institutional features underpin the quality of country-level governance institutions, which in turn has a direct negative effect on corruption in general (Barkemeyer, Preuss, & Ohana, 2018). Corruption acts like a tax on firms, but is more distorting (Wei, 1997). Indeed, in the corruption transaction, the additional costs are exacerbated by concealment, arbitrariness, and uncertainty embedded into it. These features of the corrupt transaction exist due to the poor organization of bureaucracy, and bureaucrats' discretionary power (Wei, 1997), and are reduced by high quality governance institutions. In parallel, high-quality governance institutions increase the likelihood of detection and punishment for corrupt participants in the transaction (Treisman, 2000), and the associated costs tend to reduce corruption.

High quality governance institutions are necessary and complementary for an e-procurement system, e-government, and anti-corruption reforms in general to be effective (Meagher, 2005). As an illustration, South Korea, a pioneer given its successful early experience with e-government and e-procurement, has also been the world leader in the transfer of these technologies to developing countries, but this has been argued to have exacerbated corruption instead of curbing it (Schopf, 2019). The explanation put forward for this unexpected result is that Korea, for economic and political motives, channeled these technology transfers and their support essentially to authoritarian or non-democratic countries, with governance institutions of poor quality, and that Korea did not aim to improve these institutions (ibid). It may then seem paradoxical that authoritarian and non-democratic regimes, commonly seen as being motivated by greed, capturing the resource rent of the country, and supporting a corruption system for personal enrichment, adopt anti-corruption reforms such as e-government systems. A cynical explanation is that policymakers that are corrupt or willing to protect a corruption system, may have no intention to reform, but adopt anti-corruption measures, such as an e-procurement system, in order to avoid more meaningful policies. In the meantime, this enables them to send external and internal signals. Externally, this satisfies international agencies, investors and donors concerned with the dissipation of their financings because of corruption. Internally, this raises legitimacy towards domestic constituents (Heilbrunn, 2004). A corrupt regime may then easily undermine the reform that has officially been adopted, for instance by not allocating the necessary resources to it, or by making sure that no independent domestic agency is able to raise and prosecute corruption cases (Meagher, 2005).

In sum, high quality governance institutions are necessary in order to ensure the appropriate design, implementation and enforcement of an e-procurement system, so that it actually minimizes TCE-related causes of transaction costs (Husted, 1994; Prasad & Shivarajan, 2015; Williamson, 1985). Only then it reduces informational uncertainty through the disclosure of all information on public procurement procedures, raises transparency of decision-making, mitigates asset specificity in the manager-bureaucrat relation by removing face-to-face interactions and, consequently, reduces firm corruption. Such a necessary and complementary condition of the quality of governance institutions for the effectiveness of e-government systems, modeled as a moderating effect of the former on the relationship between the latter and corruption, has been shown empirically in cross-country studies (Fan et al., 2021; Kim, 2014; Kochanova et al., 2020). The same relationships are likely to occur in the case of e-procurement systems, and this leads us to hypothesize that:

Hypothesis 2. The quality of country-level governance institutions moderates the impact of a country-level e-procurement system on firm corruption to secure public contracts.

Reliable access to internet services, and the ability of business and wider society to access them without tremendous cost in terms of time and resources, are important preconditions for effective e-government and e-procurement. This issue is critical in countries that suffer from weak coverage and diffusion of Information and Communication Technologies (ICT) (Lewis-Faupel et al., 2016). According to the OECD (2019), another main barrier limiting the effectiveness of e-procurement systems is the lack of workforce capabilities in this context. This concerns new technologies and managerial abilities related to operating new system, data, security and organizational change (Ware et al., 2007), and the necessary training that must be delivered to civil servants as well as businesses. The digitalization of public procedures can be hindered by lack of appropriate skills of various managers, and the unsuitable choice of hardware and software, potentially making it unable to deliver its potential in terms of corruption reduction (Fleming et al., 2022). Education and information programs should also be designed for other stakeholders in order to raise public awareness, civil oversight (Schapper, 2008), and to reduce suspicion about security and information governance, which is a source of inertia and resistance towards e-government (Khorana et al., 2015).

In a context of digital divide, due to a lack of ICT infrastructures, the uneven access and use of the internet across firms, or uneven capabilities to use e-procurement procedures, an e-bidding requirement would distort competition and potentially exacerbate corruption instead of

[2] [2] This may also stem from the inappropriate design of an e-procurement scheme: if, for example, it has been developed for an industrialized country, and then, is transposed and ill-adapted to another developing country (Heilbrunn, 2005).

curbing it (Lewis-Faupel et al., 2016). Implementing e-government in this context exacerbates the problem of information asymmetry, which in turn reinforces corruption and the inequal distribution of resources in favor of those who have access to information (Kim, 2014). This is because, for instance, information asymmetry amplifies the informational and behavioral uncertainties in the bureaucrat-manager relationship that characterizes public procurement.

E-procurement is not just about technical adoption and the implementation of a software, but this is a reform program in itself, complementary to other reforms and laws, and it requires new institutional settings and organizational change (Schapper, 2008; Seong & Lee, 2004). Appropriate institutional settings must go through the simplification of procurement laws and regulations, and the standardization of procedures for greater transparency (Ware et al., 2007), which will in turn enable to decrease behavioral uncertainty. Legal and technical provisions must ensure confidentiality, reliability, and thus ultimately trust in the e-procurement process (Khorana et al., 2015). In the absence of these provisions, uncertainty is a source of monitoring and control costs for firms (Williamson, 1985). The implementation of ICT within firms' operations can only deliver fully its potentials if it is accompanied by necessary organizational changes, and the same holds for the public administration sector (Seri & Zanfei, 2013). Failure to do so would hamper an e-procurement scheme's ability to ensure better corruption control, administrative simplification, transparency, fairness and trust, i.e., factors that, as TCE shows, allow to mitigate asset specificity in the bureaucrat-manager relation (Husted, 1994), thereby reducing transaction costs and, consequently, lower firms' payment of bribes (Knack et al., 2017).

In sum, the effectiveness of an e-procurement system will be contingent upon a set of resources and capabilities encompassing human capital, technology, infrastructures, institutional and organizational provisions as well as legitimacy via verification (World Bank. (2016), 2016), and that are constitutive of an enabling business environment (Khorana et al., 2015). These are a necessary condition enabling a country to realize the potential of e-government as an anti-corruption tool (Khan et al., 2021). This is consistent with the CRT that has shown the extent to which organizations must gather resources and build capabilities so as to fully realize the benefits of an innovation or a technology (Teece, 1986). Conversely, the absence of one or several of these resources may even make things worse, (Schapper, 2008), fostering corruption (Lewis-Faupel et al., 2016).

This diverse set of resources that are not just financial and technical in nature, but also rest on expertise in the design of e-procurement systems as well as capabilities in using them, are gathered through supranational support. On the contrary, bilateral cooperation for e-procurement alone, as demonstrated by South Korea's initiatives, has proven inefficient or counter-productive (Schopf, 2019). Depending on their levels of development and experience with e-government, countries may need one or several of these resource types, and obtain them through supranational support (ADB/OECD, 2008).

This support delivered by experts and consultants includes for instance helping to build technological infrastructures, develop and set up electronic portals, reform procurement laws, regulations and procedures, as well as training procurement officers in order to raise their capacities (World Bank. (2020), 2020). This financial, technical and human support aims at ensuring that an e-procurement system fully delivers the expected outcomes, in particular better control of corruption. It is not restricted to the public sector, but also aims at training business stakeholders and reforming the business environment (World Bank, 2015, 2018).

The supranational support of e-procurement systems (and the lack thereof) also mirrors the distinction between symbolic and substantive implementation of firm-level policies, for example in the context of certifiable standards (Christmann & Taylor, 2006) or corporate codes of conduct (Westphal & Zajac, 1994, 2001). Actors may choose to adopt certain policies for mostly symbolic purposes. In other words, policy adoption is largely decoupled from actual practices on the ground (Meyer & Rowan, 1977). Third-party involvement in order to verify the credibility of a given system or policy is seen to reduce this decoupling and thus forms a prerequisite for its substantive implementation (King, Lenox, & Terlaak, 2005). Along these lines, the indication of supranational support for e-procurement systems then signals that a certain set of necessary conditions has been met for the effective functioning of this system. Thus, in countries with an e-procurement system in place that received supranational support, one should observe that firms pay relatively less bribes in order to secure public contracts, when compared to firms in countries without such support.

We therefore propose the following hypothesis:

Hypothesis 3. Supranational support moderates the impact of a country-level e-procurement system on firm corruption to secure public contracts.

3. Method

3.1. Sample

Our sample originates from the World Bank Enterprise Survey (WBES). This database is based on a stratified random sampling methodology from the population of publicly listed firms in a wide range of different countries. As previous studies have emphasized (e.g., Ayyagari, Demirgüç-Kunt, & Maksimovic, 2011; Nuruzzaman, Singh, & Gaur, 2020), the World Bank ensures data accuracy and reliability is very high by securing confidentiality, conducting the survey through private contractors rather than government agencies, and consistently checking for irregularities and inconsistencies in the responses and re-contacting enterprises to correct any discrepancies. Further, the survey includes sections that must be answered by different people within the company, which reduces concerns regarding common method bias (Chang, Van Witteloostuijn, & Eden, 2010). Unfortunately, the WBES dataset does not include information about the home country of foreign firms in each country, which prevents us from controlling for home-country characteristics that could have an influence (e.g., whether the home country has signed the 1997 OECD Anti-bribery Convention). For this reason, we focus on domestic firms and we include in our sample firms with 10% or less of foreign ownership (as robustness tests, we applied both higher and lower cut-off thresholds). Thus, we compiled a sample of 8,373 firms in 72 countries from 2008 to 2019 for which data on our explanatory variables was available. The list of countries included in the sample is shown in Table 1 (23 countries out of 72 have their e-procurement system supported by the World Bank and are denoted with an asterisk).

3.2. Variables

3.2.1. Dependent variable

As stated by Knack (2007), the advantage of firm surveys (such as the Enterprise Survey among others) is that they can provide specific measures on corruption such as contract values paid as bribes to public officials, allowing more in-depth analyses of bribing heterogeneity across firms (Krammer, 2019). Thus, we measure firm corruption using the responses to the question from the survey: "When establishments like this one do business with the government, what percent of the contract value would be typically paid in informal payments or gifts to secure the contract?"

It is worth noting that previous studies have found no perception bias that could lead to systematic differences in the degree of criticism towards public officials in the responses of aggregated measures of corruption in large-scale surveys (Krammer, 2019; Razafindrakoto & Roubaud, 2010). In addition, and following standard practices on surveying sensitive issues, the question was phrased indirectly in order to increase the truthfulness of the responses by not implicating the

Table 1
List of host countries.

Afghanistan	Indonesia*	Paraguay*
Angola	Jamaica*	Peru*
Argentina	Jordan*	Philippines
Armenia	Kazakhstan*	Romania
Azerbaijan	Kenya	Samoa
Bangladesh*	Kosovo	Senegal
Belarus	Kyrgyz Republic	Serbia
Belize	Lebanon	Sudan
Benin	Lesotho	Suriname*
Bhutan	Liberia	Tajikistan*
Bolivia	Madagascar*	Tanzania
Bosnia and Herzegovina	Malaysia	Thailand
Bulgaria	Mali	Timor-Leste
Cambodia	Mauritania	Tonga
Chad	Mauritius	Tunisia*
Chile	Moldova*	Turkey
Colombia*	Mongolia*	Uganda
Ecuador	Montenegro	Ukraine
Georgia*	Morocco*	Uruguay*
Ghana	Myanmar	Uzbekistan*
Greece	Nepal*	Vanuatu
Guatemala	Nicaragua	Vietnam*
Guyana	Nigeria*	Zambia
Honduras	Panama*	Zimbabwe*

Note: Countries with their e-procurement system supported by the World Bank are noted with an asterisk.

respondents personally (Svensson, 2003). The survey is conducted by World Bank researchers usually in cooperation with business organizations and industry associations to increase legitimacy, but not government officials, without mentioning the words "corruption" or "bribe" in the wording of the questions, and presenting the respondents as victims (Ufere, Gaskin, Perelli, Somers, & Boland, 2020).

3.2.2. Independent variables

Our independent variables come from the Global Public Procurement Database (GPPD), an initiative conducted by the World Bank with the aim of collecting information on country-level procurement and e-procurement systems worldwide. By using this data source, we also alleviate potential concerns of common method bias, as our independent variables come from a different source than our dependent variable. Specifically, the GPPD provides data on whether and when the country has implemented an e-procurement system, and also whether or not this e-procurement system is supported by the World Bank.

3.2.3. Moderating variables

The first moderating variable is the quality of governance institutions and we measure it using the Freedom House (FH) index of Government Functioning (GF). The empirical literature on corruption has shown the significant role of country-level governance institutions measured by FH indicators (Treisman, 2000, 2007). The FH GF index originates from annual experts surveys in each country, and encompasses three main dimensions (C1, C2, and C3) of governmental institutions quality: Executive and legislative representatives are freely elected, and they make and implement policies independently from the pressure of non-state interest groups (C1). There are strong and effective safeguards against official corruption (C2). This means in particular the implementation of anti-corruption laws and programs, the absence of excessive bureaucratic regulations or requirements, the existence of whistleblower protection, and independent and effective auditing and investigative agencies. The third dimension (C3) covers the principles of openness and transparency in the political and bureaucratic decision-making processes (House, 2021). The FH GF index ranges from 0 to 4, with higher values indicating higher quality of governance institutions.

The second moderating variable is the existence of supranational support. As a proxy indicator of the moderating variable supranational support, we use a dummy indicating whether or not the e-procurement system is supported by the World Bank, available in the GPPD database. The World Bank has a central role in this field, frequently intervening jointly with other supranational organizations like the OECD, or regional ones, such as the Asian Development Bank (ADB/OECD, 2008). For example, in February 2021, the World Bank approved a budget of 40 million USD in order to help Bangladesh to further expand and improve its e-procurement system in the pandemic context. The set of measures includes for instance the funding of additional e-procurement data center capacities and cyber security, expertise to settle international bidding and procurement data analytics, and training and support to small and medium firms and women-led enterprises (World Bank. (2021), 2021). World Bank support aims at improving the functioning of countries' e-procurement schemes through higher effectiveness, transparency, fairness, predictability, and overall trust in the process. To take the example of Morocco, World Bank financial and technical assistance has permitted to halve the delays of issuance of payments orders, and to guarantee the access to complaint procedures for bidders (World Bank. (2018), 2018).

3.2.4. Control variables

We build on recent research into corruption using the Enterprise Survey (e.g., Krammer & Jiménez, 2020), and include several control variables in the model. First, we include the age of the firm measured in years since its foundation. Second, we control for the size of the firm by measuring the number of employees (subject to a logarithmic transformation). Third, we account for financial accessibility with a dummy variable that takes the value 1 if the firm has a loan or credit line from a financial institution, and 0 otherwise. Fourth, we control for whether the firm conducts export activities or not by including a dummy variable that takes the value 1 if the firm exports at least 10% of its total sales, and 0 otherwise. We also add several country-level control variables. The empirical literature on the determinants of corruption has emphasized the negative impact of revenue and strength of political institutions on corruption (Mocan, 2008; Treisman, 2000, 2007). We operationalize revenue with GDP per capita and GDP growth (Ghossein et al., 2018) available from the World Development Indicators Database. The strength of political institutions is already reflected in the moderating variable quality of governance institutions, measured with the FH GF index, and we also add an indicator of the excessive fiscal burden (Treisman, 2000). Taxes are measured as the total of taxes and fiscal contributions paid by firms, in percentage of their profits, and originating from the World Bank Doing Business database. Mocan (2008) also puts forward the unemployment rate as a country-level predictor of micro-level corruption, with a negative effect. We therefore include this control variable in the model, also from the World Development Indicators Database. Finally, we include fixed effect dummies for the industry and the country in which the firm operates.

3.3. Analytical method

Given that our dependent variable is expressed as a percentage, and thus censored at both the upper (1 0 0) and lower (0) limits, we estimate Tobit models to test our hypotheses regarding the role of e-procurement systems and firm corruption. We lagged all our explanatory variables (independent and control) one year in order to account for the time that the implementation of an e-procurement system might take to have an effect on firm corruption to secure public contracts.

4. Results

Table 2 presents the descriptive statistics of the variables included in our models. Table 3 presents the correlation matrix and the Variance Inflation Factors. The low correlations between predictors and the fact that all VIFs are below the recommended threshold of 5.3 (Hair, Black, Babin, Anderson, & Tatham, 1998) both suggest that multicollinearity is not an issue.

Table 2
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Firm corruption to secure public contracts	8,373	2.264	7.828	0	100
E-procurement system	8,373	0.612	0.487	0	1
E-procurement supported by World Bank	8,373	0.352	0.477	0	1
Age	8,373	25.396	14.731	2	155
Employees (log)	8,373	2.295	1.365	0	11.512
Access finance	8,373	0.523	0.499	0	1
Exporter	8,373	0.101	0.302	0	1
Government Functioning	8,373	5.410	2.666	0	12
Taxes	8,373	42.709	19.335	8.4	120.8
GDP per capita	8,373	9.286	6.620	0.923	31.467
GDP growth	8,373	4.915	3.837	−5.918	25.463
Unemployment	8,373	7.0649	5.787	0.39	47.5

Table 3
Correlation matrix and VIFs.

	1	2	3	4	5	6	7	8	9	10	11	12	VIF
Firm corruption to secure public contracts	1												–
E-procurement system	−0.00	1											2.09
E-procurement supported by World Bank	−0.00	0.58*	1										1.80
Age	−0.02*	0.00	−0.08*	1									1.11
Employees (log)	−0.01	−0.01	−0.02*	0.14*	1								1.09
Access finance	0.03*	−0.02*	0.07*	−0.14*	−0.00	1							1.11
Exporter	0.03*	0.05*	−0.01	0.08*	0.12*	−0.05*	1						1.04
Government Functioning	−0.01	0.00	0.06*	0.14*	−0.17*	−0.19*	0.01*	1					1.18
Taxes	−0.00	0.04*	−0.11*	0.14*	0.00	−0.08*	0.00	−0.06*	1				1.13
GDP per capita	−0.10*	0.28*	−0.07*	0.06*	−0.03*	−0.19*	0.09*	0.21*	0.14*	1			1.41
GDP growth	0.03*	−0.24*	0.05*	−0.15*	0.07*	0.20*	−0.06*	−0.17*	−0.25*	−0.25*	1		1.32
Unemployment	−0.07*	−0.11*	−0.15*	0.04*	−0.02*	−0.09*	0.06*	0.11*	0.00	0.24*	−0.18*	1	1.16

Notes: * $p < 0.05$.

We show the results obtained from the Tobit regressions in Table 4 (Models 1–5). In Hypothesis 1, we proposed a negative relationship between a country-level e-procurement system and firm corruption. The e-procurement system coefficient in Model 2 is not significant ($\beta = 1.895$, $p > 0.1$), in line with our central tenet that in order to capture the effect of the adoption of an e-procurement system on firm corruption, it is critical to account for additional factors in the analysis. In Hypothesis 2, we proposed that the quality of country-level governance institutions strengthens the negative association between a country-level e-procurement system and firm corruption to secure public contracts. To test this hypothesis, we added the interaction between e-procurement system and Government Functioning index to Model 3. First, we observe that the e-procurement system coefficient becomes negative ($\beta = -8.517$, $p < 0.01$), indicating that when countries have an e-procurement system in place and we control for the interaction with the quality of country-level governance institutions, firm corruption to secure public contracts is lower. Hypothesis 1 is therefore supported. Second, the coefficient of the interaction term is positive and significant ($\beta = 1.925$, $p < 0.01$), indicating that the higher the quality of governance institutions, the more pronounced the negative association between e-procurement system and firm corruption to secure public contracts. Hypothesis 2 is therefore also supported.

In Hypothesis 3, we proposed that the negative relationship between a country's adoption of an e-procurement system and firm corruption is strengthened by the presence of supranational support, ensuring the provision of the set of resources that are necessary for effective implementation. To test this hypothesis, we added in Model 4 the variable e-procurement supported by World Bank (X) and its interaction with the variable e-procurement system (Y). The moderation between these two variables X and Y was modeled and tested empirically as follows:

$$a + bX + cY + dX^*Y \quad (1)$$

Since both variables X and Y are dummy variables, and the countries that have an e-procurement system supported by the World Bank (for which $X = 1$) form a subset of all countries that have adopted an e-procurement system (for which $Y = 1$), there is no observation such that $X = 1$ and $Y = 0$ and we have $X = X^*Y$.[3] Therefore, equation (1) is reduced to $a + b'X + cY$, with b' standing simultaneously for b and d, the direct effect of the supranational support (i.e., World Bank supported or not) on firm corruption, and the interaction effect between the variables e-procurement system and supranational support.[4]

The results obtained for Model 4 indicate a negative and significant coefficient for the variable e-procurement supported by World Bank ($\beta = -6.941$, $p < 0.05$). This means that the negative impact of a country-level e-procurement system and firm corruption to secure public contracts is stronger when the system benefits from the supranational support, thereby supporting Hypothesis 3. This also means that a well-designed e-procurement system that is implemented with all the necessary resources based on support provided by the World Bank, has a negative direct impact on firm corruption, thus lending further support to Hypothesis 1. We observe that the e-procurement system coefficient becomes positive and significant ($\beta = 6.203$, $p < 0.05$), as it now only captures the effect of a poor-quality e-procurement system (not supported by the World Bank).[5]

Finally, in Model 5 we included the two interaction effects between e-procurement system and Government Functioning and e-procurement supported by the World Bank. The coefficients of the interaction terms remain significant and respectively positive ($\beta = 1.994$, $p < 0.01$) and negative ($\beta = -7.503$, $p < 0.01$), thus supporting all hypotheses and in line with the previous results.

The results of control variables show that GDP per capita and firm size as measured by the total of employees have a negative relationship with firm corruption. This is consistent with earlier findings, as reviewed for instance in Knack et al. (2017). Unemployment is also negative (Mocan, 2008), although only significant in two of the regressions presented in Table 4. In contrast, export status shows a positive relationship with firm corruption, and the same holds for the level of taxes, significant in three regressions, consistent with the literature (Treisman, 2000).

[3] We always have $X^*Y=X$ because observations can only be such that ($X=1$; $Y=1$), ($X=0$; $Y=1$) or ($X=0$; $Y=0$).

[4] This is verified empirically, as running alternative regressions of the models $a + bX + cY + dX^*Y$, $a + b'X + cY$, and $a + bX + dX^*Y$ lead strictly to the same results.

[5] Indeed, replacing that variable with a dummy 'e-procurement not supported by World Bank' produces similar results.

Table 4
Tobit regression results.

VARIABLES	(1)	(2)	(3)	(4)	(5)
E-procurement system		1.895	−8.517***	6.203**	−4.273
		(1.917)	(3.294)	(2.542)	(3.631)
E-procurement system * Government Functioning			1.925***		1.994***
			(0.493)		(0.494)
E-procurement supported by World Bank				−6.941**	−7.503***
				(2.690)	(2.699)
Government Functioning	−0.818	−0.759	−1.821***	−0.825	−1.937***
	(0.560)	(0.564)	(0.632)	(0.563)	(0.633)
Age	−0.0212	−0.0197	−0.0206	−0.021	−0.0218
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Employees (log)	−0.538*	−0.535*	−0.576*	−0.567*	−0.614**
	(0.303)	(0.303)	(0.304)	(0.304)	(0.304)
Access finance	−0.039	−0.030	−0.002	0.001	0.032
	(0.858)	(0.858)	(0.858)	(0.858)	(0.858)
Exporter	3.480***	3.454***	3.419***	3.426***	3.387***
	(1.303)	(1.303)	(1.304)	(1.303)	(1.304)
Taxes	0.123*	0.148**	0.0979	0.164**	0.115
	(0.07)	(0.07)	(0.072)	(0.071)	(0.073)
GDP per capita	−1.765***	−1.942***	−2.082***	−2.006***	−2.147***
	(0.272)	(0.327)	(0.333)	(0.326)	(0.332)
GDP growth	−0.168	−0.144	−0.266	−0.060	−0.182
	(0.184)	(0.185)	(0.189)	(0.187)	(0.190)
Unemployment	−0.464*	−0.444*	−0.275	−0.356	−0.171
	(0.261)	(0.262)	(0.264)	(0.264)	(0.267)
Constant	−10.25	−11.42	−5.786	−12.40	−6.691
	(11.48)	(11.54)	(11.62)	(11.55)	(11.63)
Log Likelihood	−9126.09***	−9125.60***	−9117.90***	−9122.26***	−9114.01***
Observations	8,373	8,373	8,373	8,373	8,373

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

As robustness tests, we tested the results with an alternative independent variable for the quality of country-level governance. In Table 5 we replicate our main analysis replacing the Government Functioning variable with the Freedom House Index of Political Rights and obtain results that remain qualitatively the same. In order to control further for potential multicollinearity and the stability of the estimated parameters, we also tested different specifications of the model. We first tested a model including only the control variables (Table 4, column 1). Subsequently, we tested Model 3 (displayed in Table 4) by progressively removing each control variable. All estimated parameters remain similar (magnitude, sign, and significance).[6] Furthermore, we tested the results when dropping observations for which the variable Employees (log) is 0 (312 observations removed, corresponding to firms with only 1 declared employee) as well as when including the variable in the model without logarithmic transformation, and found the same results as the ones reported above. Finally, as mentioned in the previous section, we also tested different cut-off points (5%, 25%, and 33%) as threshold of foreign ownership to consider a firm as a domestic one, and find no significant changes compared to the results previously shown.

5. Discussion

Previous research into the relationship between e-government and corruption is characterized by conflicting results and viewpoints about the underlying mechanisms. To some degree, these conflicting findings have been attributed to theoretical shortcomings of extant literature (Addo & Senyo, 2020; Khan et al., 2021). Building on the TCE perspective (Husted, 1994; Williamson, 1985), in this study we investigated the relationship between country-level e-procurement systems and firm corruption. Drawing on a sample covering 8,373 firm responses from 72 countries from 2008 to 2019, we have provided empirical evidence that firm corruption to secure public contracts is lower in countries with an e-procurement system when the interactions with the quality of country-level governance institutions and with supranational support are taken into account. Furthermore, we find that the negative effect of an e-procurement system on firm corruption is stronger when the country has high quality governance institutions and when the e-procurement system is supported by the World Bank.

Our paper makes relevant contributions to the literature on corruption and e-government. First, as a theoretical contribution, we develop a theory-driven explanation of the relationship between e-procurement and bureaucratic corruption. Building on TCE, we argue that e-procurement is likely to impact corruption through its effects on informational and behavioral uncertainties, as well as asset specificity in the bureaucrat-manager relation. The adoption of an e-procurement system has the potential to lower transaction costs as it hampers bureaucrats' opportunistic behaviors, thereby leading managers to pay less bribes to get the services they are entitled to. However, this negative effect of e-procurement on corruption is shown to be contingent upon certain contextual factors. Consistent with the notion of institutional complementarity (Hall & Soskice, 2001) and the CRT (Teece, 1986), we have demonstrated that the effect of e-procurement on corruption is moderated by the quality of country-level governance institutions, and by supranational support. The latter permits a country to gather and build the capabilities that are necessary for realizing the potentials of an e-procurement system. Our results therefore clear the empirical debate on the effectiveness of e-procurement systems to curb firm corruption (Ghossein et al., 2018; Kochanova et al., 2020). Our results also confirm those of Ghossein et al. (2018) that high quality public procurement reduces corporate corruption, as this effect holds for e-procurement, which is one constituent of this high quality. This contrasts with the non-significant results obtained by Kochanova et al. (2020), and this difference possibly originates from our much larger sample size. Importantly, our results also show that the simple adoption of an e-procurement system as an indicator is insufficient to unveil its effect on firm corruption, as this is only captured when the interactions with the quality of country-level governance institutions and supranational support are considered. We highlight that the effectiveness of an e-procurement system on its own does not guarantee reduced firm corruption

[6] [6] Results of all robustness tests are available upon request from the authors.

Table 5
Robustness tests with alternative IV (PR rating).

VARIABLES	(1)	(2)	(3)	(4)	(5)
E-procurement system		3.030	−12.29***	6.403**	−8.934**
		(1.925)	(4.037)	(2.538)	(4.348)
E-procurement system * PR rating			3.639***(0.840)		3.653***(0.840)
E-procurement supported by World Bank				−5.561**(2.724)	−5.646**(2.725)
PR rating	−3.260***	−3.557***	−6.091***	−3.119**	−5.658***
	(1.189)	(1.206)	(1.347)	(1.222)	(1.361)
Age	−0.0208	−0.0183	−0.0201	−0.0193	−0.0211
	(0.0300)	(0.0301)	(0.0301)	(0.0301)	(0.0301)
Employees (log)	−0.555*	−0.551*	−0.594*	−0.575*	−0.619**
	(0.303)	(0.303)	(0.303)	(0.303)	(0.304)
Access finance	−0.00436	0.00977	0.0349	0.0329	0.0575
	(0.857)	(0.857)	(0.857)	(0.857)	(0.857)
Exporter	3.515***	3.472***	3.354**	3.451***	3.334**
	(1.301)	(1.301)	(1.302)	(1.301)	(1.302)
Taxes	0.112*	0.147**	0.0612	0.163**	0.0778
	(0.0649)	(0.0685)	(0.0725)	(0.0696)	(0.0735)
GDP per capita	−1.802***	−2.104***	−2.269***	−2.127***	−2.288***
	(0.265)	(0.329)	(0.333)	(0.329)	(0.333)
GDP growth	−0.196	−0.155	−0.258	−0.0908	−0.196
	(0.182)	(0.184)	(0.186)	(0.186)	(0.188)
Unemployment	−0.491*	−0.460*	−0.292	−0.387	−0.215
	(0.260)	(0.261)	(0.262)	(0.263)	(0.265)
Constant	−2.963	−3.692	6.980	−5.900	4.724
	(11.88)	(11.89)	(12.14)	(11.94)	(12.19)
Log Likelihood	−−9123.42***	−9122.18***	−9112.65***	−9120.09***	−9110.50***
Observations	8,373	8,373	8,373	8,373	8,373

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

to secure public contracts, as the impact is contingent on two moderating variables, namely the quality of governance institutions and whether or not the e-procurement system benefits from supranational support, which explains why the ability of e-procurement systems to reduce corruption varies across countries according to the quality and comprehensiveness of public procurement reforms.

The conflicting results and disorganized views on the relationship between e-government or e-procurement and corruption deprive policy makers from the solid and reliable lines of arguments that would be necessary in order to make their decisions (Khan et al., 2021). Our study provides theoretical explanations of the underlying mechanisms, including the moderating effects of contextual factors, and has therefore important and useful implications for policy and practice. An e-procurement system has the potential to be effective in curbing corruption as it raises transparency, and reduces face-to-face interactions as well as government officials' discretionary power. It thus increases the risks and transaction costs of corruption, and lowers its potential benefits, thereby reducing firms' incentives to bribe in order to secure public contracts. While most countries have adopted e-procurement systems (World Bank. (2017), 2017), many have failed to do so adequately (Heeks, 2005; World Bank. (2016), 2016) and, as a result, these systems differ in terms of their performance and ability to control corruption (Schapper, 2008; World Bank. (2016), 2016).

From a policymaking perspective, this study shows that the digitalization of public procurement procedures forms a necessary but not sufficient condition for addressing corruption, and that it must be accompanied by effective governance institutions. These institutions must ensure independence and integrity, as well as transparency and accountability (Fan et al., 2021; Heilbrunn, 2004; Schopf, 2019). It must be complemented by a wider set of reforms and measures integrating human capital, technology, institutional, and organizational dimensions (World Bank. (2016), 2016). These are necessary to ensure that digitalizing the procurement process induces greater administrative simplification and effectiveness, higher transparency, predictability, and trust (World Bank, 2015, 2018), thereby lowering transaction costs (Williamson, 1985) and bribes (Knack et al., 2017). This is the purpose of the World Bank's human, technological and financial support to countries adopting e-procurement systems. This support is signaling these countries' willingness, and potentially also their ability, to better control firm corruption in public procurement processes, thus explaining our results.

These implications are equally relevant for corporate practitioners willing to develop business overseas in developing countries, and aiming to address corruption in a meaningful way. Government contracts are an important market for companies, whereas their procurement is the activity the most vulnerable to bureaucratic corruption (World Bank. (2016), 2016). The implementation of an e-procurement system, associated with international community support, signals the effectiveness of corruption prevention and control in government contracts, and thereby a lower level of risk for MNEs. A World Bank supported e-procurement system will not only ensure more effective corruption control in public procurement in general, but will also protect firms from being disadvantaged by corrupt competitors (Lewis-Faupel et al., 2016; Ware et al., 2007). Furthermore, it is worth noting that these benefits are not restricted to firms directly covered by a given country-level e-procurement system, but may also extend to firms maintaining supply chain relations with these firms (Kim & Wagner, 2021). The latter will be able to judge potential corruption risk more accurately based on a better understanding of the country-level anti-corruption measures taken in relation to public procurement.

5.1. *Limitations and avenues for future research*

We acknowledge that our paper is subject to several limitations, in turn opening up interesting avenues for future research. First, Cuervo-Cazurra (2008) argues that when the home country of an MNE has ratified the OECD Anti-bribery Convention, the liability of foreignness effect is stronger. One could therefore expect that e-procurement systems have differentiated effects on foreign firm corruption, depending on whether MNEs' home countries are signatory of the OECD convention or not. Unfortunately, our data sources do not disclose the nationality of the foreign firms and therefore we have to restrict our analyses to domestic firms. Future studies can test whether the adoption of e-

procurement systems mitigates the liability of foreignness argument. Second, we are also unable to control for the political ties, board interlocks and other top management team characteristics of the firms in our sample (Collins, Uhlenbruck, & Rodriguez, 2009). Future studies with access to this kind of data can study whether well-connected firms bribe more given their access to and closer relationships with authorities, or on the contrary they do not need to pay bribes because they compensate it with their political resources. Third, future research employing time-series data would be able to consider potential learning effects from experience of public e-bidding processes. Future studies could then analyse to what extent previous experience with e-procurement makes the firm better able to bid and participate in digital public procurement processes. Fourth, in our paper we only investigate to what extent e-procurement systems can affect firm corruption to secure public contracts, but we hope future studies deepen our understanding regarding the effectiveness of e-procurement systems in general and to what extent they achieve their objectives. Finally, we are restricted to study the countries included in the WBES for which there is available data on e-procurement, leading to a sample of 72 countries. Further research could try to widen the geographic scope to more comprehensively analyze both emerging and developed countries.

More efforts are needed to build a critical understanding of the impacts of digitalization on firm corruption, and we highly encourage researchers to focus their efforts on this fascinating avenue in order to deepen our understanding of the topic.

CRediT authorship contribution statement

Alfredo Jiménez: Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Julien Hanoteau:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ralf Barkemeyer:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors are particularly indebted to Professor Stelios Zyglidopoulos for his comments on an earlier draft of this manuscript. We are also grateful to Guest Editor Prof. Jeoung Yul Lee and the anonymous reviewers for their guidance and constructive feedback. Alfredo Jiménez acknowledges that this publication is part of the I + D + i project PID2019-104408GB-I00, funded by MCIN/ AEI/10.13039/ 501100011033/.

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