Chapter 2

PUBLIC PROCUREMENT AND THE PRIVATE BUSINESS SECTOR: EVIDENCE FROM FIRM-LEVEL DATA[1]

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I. INTRODUCTION

Governments set and implement the rules that guide the economy. Governments also use resources to provide public goods such as infrastructure. Public procurement is the one area where both government spending and government rule setting come into play. The size of public procurement in most economies is significant. On average public procurement makes up about 14.5 percent of GDP, with countries such as Eritrea and Angola going up to as high as 33% and 26% respectively (Djankov, Ghossein, Islam, & Saliola, 2017). In developing economies, public procurement can go up to 50% or more of total government expenditure (Knack, Biletska, & Kacker, 2017). The quality of public procurement can have far-reaching effects throughout the economy given their magnitude.

Poor public procurement systems can incur significant costs on the economy. Opaque systems can increase rent-seeking behavior. Favoritism in awarding contracts can increase corruption, discouraging fair competition that could otherwise drive prices down and increase quality (World Bank, 2016). A fair and transparent public procurement system can encourage greater firm participation, decrease corruption, and improve the quality of public goods such as infrastructure. The use of online procurement portals can also encourage online connectivity in the private sector. Public procurement systems can also push the boundaries of innovation in the private sector. Using rich firm-level data we explore the far-reaching effects of public procurement systems throughout the business sector. We test whether public procurement systems are correlated with firm engagement in procurement, the prevalence of

corruption in the business sector, the losses faced by firms when shipping domestically, firm innovation, and online connectivity.

Public procurement literature has explored certain aspects of public procurement and linked it to a number of outcomes. Several studies have explored the role of discriminatory public procurement policy (Vagstad, 1995; Krasnokutskaya & Seim, 2011; Nakabayashi, 2013). Branco (2002) explores the effects of favoritism in procurement on technology adoption. Strands of the literature have focused on other elements of public procurement such as audits (Di Tella & Schardgordsky, 2003), competition (Estache & Iimi, 2008; Ohashi, 2009), and reputational mechanism (Spagnolo, 2009). Very few studies have explored the effects of the overall public procurement system.

The study builds on two recent articles in the literature that study the overall public procurement system. We use the public procurement score created by Djankov et al. (2017) to explore the effects of public procurement on road-quality outcomes at the country-level. The data source is the World Bank's Benchmarking Public Procurement database (BPP). The public procurement score adopts a lifecycle approach. Main stages of the procurement lifecycle are identified - bid preparation, bid and contract management, and payment of suppliers. An aggregated score of public procurement (PP Overall Index) is crafted that incorporates important aspects of these stages. A higher score implies a higher quality of the public procurement system. The second closely related study is by Knack, Biletska, and Kacker (2017) that also uses country-level measures of public procurement and links it to firm-level engagement and corruption. We build on this study in two ways. First, we explore a larger range of outcomes capturing infrastructure quality and innovation. Second, Knack, Biletska, and Kacker (2017) utilize the public procurement data from the Public Expenditure and Financial Accountability (PEFA) assessments.

PEFA assessments are built on the likelihood of accomplishing desirable outcomes based on seven pillars of performance. There is some thematic overlap between the BPP and PEFA assessments, particularly with regards to two of PEFA's pillars: Predictability and control in budget execution and Accounting and reporting. The BPP database is far more extensive in covering specific details of the

public procurement system, going beyond the aggregate assessments in PEFA. Whereas BPP presents an assessment of the regulatory framework applicable to public procurement, PEFA does not measure the legal framework nor institutional capacity affecting public financial management. The PEFA does also have some comparability challenges given that assessments are done at the national level for some countries, and at the sub-national level for others (e.g. Afghanistan as opposed to Albania). Finally, although the quality of PEFA assessments has improved over time, only 18% of draft reports submitted in FY 2015 were awarded a PEFA CHECK, a non-mandatory yet indicative quality endorsement of the assessment requiring for it to undergo a multi- step peer review process

This is the first study to combine the World Bank's Benchmarking Public Procurement database and firm- level data from the World Bank Enterprise Surveys. We find that better quality of public procurement systems is correlated with positive firm engagement, infrastructure, innovation, and internet connectivity outcomes. Better quality of public procurement systems is also related to lower levels of corruption in the private sector. The rest of the paper is organized as follows. Section 2 lays out the conceptual considerations and section 3 describes the data. Section 4 provides the empirical estimation strategy, while section 5 presents the results and section 6 concludes.

II. CONCEPTUAL CONSIDERATIONS

In this section, we describe the number of ways the quality of public procurement can influence the five outcomes of interest: firm participation, infrastructure, corruption, innovation, and online connectivity.

2.1. Firm Participation

The goal of good procurement systems is to encourage competition between firms bidding for contracts. Transparency and accessibility can lead to greater firm participation in the bidding process. Transparency and accessibility will inform a larger number of firms of procurement opportunities, and also encourage productive firms to participate given the trust generated from an open process.

Greater participation of firms has several benefits, both pecuniary and ones related to the well-functioning of the procurement system. Non-competitive procedures in the procurement process can lead to increases in costs by more than 30 percent or more (Hoekman, 1998). But cost is not the only factor of concern. Better value for money and improved quality of goods and services are also a result of a healthier competition. Increased competition can reduce the chances of bidder collusion. It gives the public more confidence in the way public funds are spent and equips them with a powerful accountability tool. It is the main pathway through which most of the other outcome variables addressed below are affected. Thus, the empirical analysis must establish the first order effect increased participation of the private sector due to high quality public procurement systems. Initial evidence is suggestive that this is the case (Knack, Biletska, & Kacker, 2017).

2.2. Infrastructure

A good procurement system increases the chances that productive firms will be awarded the contract, leading to delivery of high quality products. Given that government procurement products involve large infrastructure products, hiring productive firms will lead to timely and better quality of infrastructure projects. Lewis-Faupel, Neggers, Olken, and Pande (2016) finds that the use of e-procurement for example leads to increases in road quality in India. Djankov et al. (2017) finding a positive correlation in cross country data between better quality public procurement systems and infrastructure quality.

2.3. Corruption

Poor public procurement systems characterized by a lack of transparency can be a channel through which corruption permeates throughout an economy. The lack of transparency and competition can allow public officials to use public procurement as a means of eliciting bribes. When procurement is less transparent, government officials use discretion to decide which firms received the contract, creating a breeding ground for corruption (Ohashi, 2009). Poor public procurement systems have been found to be vulnerable to corruption (Auriol, Straub, & Flochel, 2016). In addition, opaque public procurement systems can also set the tone for other transactions

between the government and the private sector and promote inefficiencies. Thus, if a poor public procurement system signals lower costs of rent-seeking behavior, other arms of the government may also engage in rent-seeking activities. Open competition may not be sufficient to deter corruption. Contracts can be awarded to the firm offering the highest bribe instead of the firm offering the highest quality or lowest price (Knack, Biletska, & Kacker, 2017). Mironov and Zhuravskaya (2016) show that when procurement contracts are determined by bribes, less productive firms are awarded contracts.

2.4. Innovation

Public procurement systems can be used as a tool to improve innovation and technology adoption in the private sector (Branco, 2002; Hommen & Rolfstam, 2009). To be competitive in bidding for procurement contracts, firms may have to be innovative and adopt technologies to reduce costs. Public procurement can directly require innovation to be a criteria in winning the bid, thereby promoting innovation in the private sector. Furthermore, focusing on innovations in the final product can induce innovation in the private sector (Edler & Georghiou, 2007). Rothwell and Zegveld (1981) found that state procurement triggered greater innovation impulses in more areas than did R&D subsidies. Geroski (1990) determined that procurement policy "is a far more efficient instrument to use in stimulating innovation than any of a wide range of frequently used R&D subsidies". As recent policy reviews have shown, public procurement innovation is at the heart of many innovation policy initiatives across the OECD and at EU level (Izsak & Edler, 2011; OECD, 2011; Rigby et al., 2012; Uyarra, 2016). Moreover, early engagement of suppliers is an important element in procurement for innovation. Through foresight effort and other joint activities, a common and identification of needs can be shared between the demand and supply sides. When used as a policy to promote innovation, public procurement will generate varying degrees of collaboration and interactive learning (among procurers, suppliers and – sometimes – other organizations), which is a central determinant of the development and diffusion of innovations (Edquist, Vonortas, Zabala-Iturriagagoitia, & Edler, 2015). Finally, the public sector can lower the risk for the developing firms and subsequent customers by

acting as a *launching customer* for innovative technologies and solutions (European Commission, 2005).

2.5. Online Connectivity

Online connectivity is a more direct outcome from public procurement than innovation, although the mechanisms at play are similar. External pressure is a key motivator in the adoption of internet technologies by firms (Mehrtens, Cragg, & Mills, 2001). Public procurement, through e-procurement, can directly lead firms to adopt internet technologies as it is a requirement to fully harness the procurement process. Finally, the e- procurement can generate competitive pressures as firms compete with each other by adopting internet technology in order to outdo each other to win the contract. The latter is more likely to be true for Small and Medium Sized (SME) enterprises in developing economies.

III. DATA

The analysis is based on two datasets - the World Bank Group's Enterprise Surveys (ES) and the World Bank Group's Benchmarking for Public Procurement databases. The ES consist of firm- level data that captures a firm's business environment. The respondents are typically managers or owners of the business. In addition, a firm's characteristics and performance are measured. The ES conducted between 2006 and 2016 used a common questionnaire and sampling methodology (stratified random sample) across economies, thereby allowing for cross-country comparisons, which is a rarity in most datasets. The surveys are representative of the formal (registered) private sector of the economies excluding extractive sectors such as mining as well as Agriculture.[2] Measures of participation in public procurement, corruption, infrastructure, innovation and online engagement available in the ES are utilized for the analysis in this study. The sample of ES firms in this study includes over 59,000 firms across 109 mostly developing economies. The list of counties is provided in Appendix A.

The public procurement data is based on structured expert surveys. This database has also been used by Djankov et al. (2017). Respondents were chosen based on their expertise in the public procurement law as well as advisory experience for businesses

willing to provide services to the government. The respondents range from private sector companies, professionals in law firms, accounting firms, business advisory firms, chambers of commerce, legal bar associations, to public officials dealing with public procurement. Over 1,900 experts provided information that was coded World Bank team managed by one of the authors. To enable cross country comparisons, a hypothetical scenario was developed to anchor survey responses, similar to the approach by Djankov et al. (2002). The standardized case study entails assumptions on three elements: (i) the procuring entity, (ii) the bidding company, and (iii) the public call for tender. The procuring entity is restricted to a local authority located in the economy's largest business city, and is planning to resurface a flat two-lane road with asphalt. The bidding business is assumed to be a limited liability company that also operates in the economy's largest business city, and is 100 percent domestically and privately owned. The bidding business is assumed to have previously responded to public calls for tender and won similar-size service contracts. The following assumptions are made regarding the public call for tender. First, it is initiated by the procuring entity. Second, it follows an open and competitive process. Third, the public tender concerns the resurfacing with asphalt of a flat two-lane road. The value is defined as the greater of: (i) 91 times the economy's income per capita or (ii) $2 million.

The methodology does have a few limitations. First, the surveys are not based on a representative sample. The assumption is that the public procurement is within the scope of experienced experts and therefore a small number of experts would be able to respond with precision to the survey. Second, the data are cross-sectional for a single year (2016). Finally, the data focuses on a set of procurement indicators in the largest business city, thereby ignoring the heterogeneity of public procurement within economies, especially large federal states.

IV. EMPIRICAL ESTIMATION

By combining firm-level heterogeneity in outcome indicators with country-level variation in public procurement, we estimate the following equation for firm *i* in country *j* and sector *r*:

$$FirmOut_{ijr} = \propto_0 + \beta_1 PP_j + \beta_2 Age_{ijr} + \beta_3 Size_{ijr} + \beta_4 multi_{ijr} + \beta_5 train_{ijr} + \beta_6 exper_{ijr} + \beta_7 export_{ijr} + \beta_8 foreign_{ijr} + \beta_9 finance_{ijr} + \beta_{10} crime_{ijr} + \beta_{11} GDPcap_j + \beta_{12} GDPgr_j + \beta_{13} LndAr_j + \beta_{14} CmnLaw_j + \gamma srvcs_r + \mu region_c + \epsilon_{ijr} \quad (1)$$

Legend:

FirmOut: Firm outcomes including firm participation in public procurement, road infrastructure, corruption, innovation, and online engagement.

PP: Public procurement regulatory quality over the whole public procurement lifecycle

Age: Firm age

Size: Firm size

multi: Firm is part of a larger firm

train: Firm offers formal training

exper: Years of experience of the top manager

export: Exporter status

foreign: Foreign ownership

finance: Access to finance

crime: Experienced losses due to crime

GDPgr: Growth rate of GDP per capita

GDPcap: Level of development – GDP per capita

LndAr: Land area

srvcs: Service sector

region: Continental fixed effects

CmnLaw: common law countries

In Equation (1) above, several outcome variables are regressed on the quality of public regulatory quality using OLS or Probit estimation models depending on the outcome variable. Various factors are accounted for. These are all described in detail below.

We use five main types of firm-level outcome variables to capture different dimensions of the private sector ($FirmOut$) obtained from the Enterprise Surveys (ES). These include firm participation in public

procurement, road infrastructure, corruption, innovation, and online engagement. For public procurement participation, we use the variable capturing whether or not a firm attempted or secured a government contract in the last 12 months. About 19 percent of firms attempted or secured a government contract. The same measure was used by Knack, Biletska, and Kacker (2017). For road infrastructure quality, we use the measure of the percentage of products lost to breakage or spoilage during shipping to domestic markets. A similar measure has been used by Aterido, Hallward-Driemeier, and Pages (2011). Around 1 percent of product value was lost for firms in the sample due to breakage and spoilage during domestic shipping. Corruption is measured a binary variable capturing whether a firm experienced at least one bribe request across size public transactions. About 18 percent of firms faced corruption.

Innovation is captured through five variables. These include: whether the firm has engaged in product innovation, process innovation, spent on R&D, used technology licensed from foreign firms (manufacturing firms only), and whether the firm has an internationally-recognized quality certification. Paunov (2016) used internationally-recognized quality certifications. Crowley and McCann (2017) has used the measures of product and process innovation to capture the incidence of innovation. Around 34 percent of firms engaged in product innovation. The corresponding rates for process innovation, R&D spending and internationally-recognized quality certificate are 37 percent, 16 percent, 18 percent respectively. Around 14 percent of manufacturing firms use technology licensed from foreign firms. Online engagement is captured by two variables. One is whether firms use email to engage with clients and suppliers. Second is whether firms have their own website. Around 73 percent of firms use email to engage with suppliers and clients while 44 percent have their own website. Summary statistics and variable descriptions are provided in Table 1 and Appendix A respectively.

Our main variable of interest is a measurement of public procurement regulatory quality over the whole public procurement lifecycle (PP). This measure is taken from Djankov et al. (2017).

The public procurement index captures three crucial phases of the public procurement lifecycle - (i) bid preparation, (ii) bid and contract management, and (iii) payment to suppliers. Bid preparation

includes needs assessment and the call for tender. Bid and contract management covers various aspects such as eligibility of foreign firms, availability of online bid submission, the existence and requirements for bid security, bid evaluation criteria, the use of model contracts with standard clauses for awarding a contract, and measures capturing the terms of modifications to the procurement contract. The payment of supplier indicator captures the number of procedures required to request payments, the timeframes for processing and disbursing payments, and how delayed payments are handled. The overall public procurement index is an amalgamation of all three aspects of the public procurement lifecycle. A higher score implies higher quality of the public procurement system. Summary statistics and variable descriptions are provided in Table 1 and Appendix B respectively. Further details of the overall public procurement index and the specific survey questions can be found in Djankov et al. (2017).

Our empirical strategy follows Paunov (2016) in addressing concerns of endogeneity. First, given that aggregate country-level measures of public procurement quality are employed, endogeneity concerns are limited in comparison to firm-level measures. It is unlikely that various firm-level outcomes would be able to influence the aggregate quality of public procurement. There are concerns of omitted variable bias. To address this, the analysis employs a large number of control variables as indicated in Equation (1). Firm-level characteristics are such as firm age (*Age*) and (*Size*), which are important correlates of firm performance, are accounted for. Other firm-level covariates include whether the firm is part of a larger firm (*multi*), whether firm offers formal training (*train*), experience of the top manager (*exper*), exporter status (*export*), foreign ownership (*foreign*), access to finance (*finance*), and crime (*crime*). The measure of crime is whether or not firms experienced losses from crime. Access to finance is proxied using two variables– whether the firm as a checking or savings account and whether the firm has a line of credit or loan.

We control for the current state of labor markets by capturing aggregate demand through the growth rate of GDP per capita (*GDPgr*). Finally, we also account for the level of development (*GDPcap*) and land area (*LndAr*) following Knack et al. (2017). We also worry about industry-specific factors and region (continent)

TABLE 1
Summary Statistics

Dependent Variables	Obs	Mean	Std. Dev.	Min	Max
Government Contract Secured or Attempted in the last 12 months Y/N	59,816	0.19	0.39	0.00	1.00
Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)	48,447	1.07	4.49	0.00	100.00
Experienced at least one Bribe Payment Y/N	42,117	0.18	0.38	0.00	1.00
Product Innovation Y/N	51,838	0.34	0.47	0.00	1.00
Process Innovation Y/N	50,526	0.37	0.48	0.00	1.00
R & D Expenditure Y/N	50,736	0.16	0.36	0.00	1.00
Technology licensed from foreign firms Y/N	31,257	0.14	0.35	0.00	1.00
Internationally Recognized Quality Certification Y/N	60,178	0.18	0.38	0.00	1.00
Firm Uses email to Interact with Clients/ Suppliers Y/N	61,518	0.73	0.45	0.00	1.00
Establishment has its Own Website Y/N	61,436	0.44	0.50	0.00	1.00
PP Overall Index	61,518	0.62	0.11	0.18	0.85
Log of GDP per capita (constant 2010 US$)	59,816	8.15	1.02	5.40	10.39
GDP per capita growth (annual %)	59,816	3.62	2.82	-8.14	11.60
Log of land area (sq. km)	59,816	13.2	2.05	5.56	16.61
Legal System: Common law	59,816	0.34	0.47	0.00	1.00
Log of age of firm	59,816	2.52	0.76	0.00	5.25
Log of size	59,816	2.82	1.11	0.00	12.03
Firm is part of a larger firm Y/N	59,816	0.17	0.37	0.00	1.00
Firm offers formal training Y/N	59,816	0.34	0.48	0.00	1.00
Top manager experience in sector (years)	59,816	17.1	10.7	0.00	60.00
Direct exports 10% or more of sales Y/N	59,816	0.11	0.32	0.00	1.00
Foreign ownership Y/N	59,816	0.11	0.31	0.00	1.00
Establishment has checking or savings account Y/N	59,816	0.88	0.32	0.00	1.00
Establishment has a line of credit or loan Y/N	59,816	0.36	0.48	0.00	1.00
Firm experienced losses due to crime Y/N	59,816	0.20	0.40	0.00	1.00
Service Sector Firm (Y/N)	59,816	0.68	0.47	0.00	1.00

specific factors. We account for sector using a dummy variable for the service sector (*srvcs*), with manufacturing being the omitted sector. Similarly we use continent fixed effects (*region*) to account for time-invariant regional factors. Finally, certain countries with common law systems may adopt different public procurement system as the scope of the public procurement regulations may be reduced. This accounted for using a dummy variable for common law countries (*CmnLaw*). Summary statistics can be found in Table 1, with data description and sources provided in Appendix B.

V. RESULTS

Table 2 presents the findings for firm participation in public procurement, road infrastructure quality, and corruption. Better public procurement systems are positively associated with higher participation of firms in public procurement. The coefficient of the public procurement variable is positive and statistically significant at the 1% level. This finding is consistent with Knack, Biletska, and Kacker (2017). Higher public procurement scores (better quality) is negatively correlated with corruption and product lost to breakage or spoilage during shipping in domestic markets and corruption. The coefficient of public procurement is negative and statistically significant at the 1% level for the corruption estimation, and 5% for the domestic infrastructure quality estimation.

TABLE 2
Public Procurement and Participation, Infrastructure and Corruption Outcomes

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N	Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)	Experienced at least one Bribe Payment Y/N
	Probit (Marginal Effects)	OLS	Probit (Marginal Effects)
	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.123***	-1.111**	-0.180***
	(0.039)	(0.435)	(0.041)
Log of age of firm	-0.015**	-0.016	-0.001
	(0.006)	(0.063)	(0.007)
Log of size	0.025***	-0.171***	0.009**
	(0.004)	(0.045)	(0.004)
Firm is part of a larger firm Y/N	-0.023*	-0.114	0.006
	(0.013)	(0.139)	(0.013)
Firm offers formal training Y/N	0.075***	0.217	0.001
	(0.009)	(0.132)	(0.010)
Top manager experience in sector (years)	0.002***	-0.004	-0.001***
	(0.000)	(0.005)	(0.001)

TABLE 2 (Continued)

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N	Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)	Experienced at least one Bribe Payment Y/N
	Probit (Marginal Effects)	OLS	Probit (Marginal Effects)
	Coef/Se	Coef/Se	Coef/Se
Direct exports 10% or more of sales Y/N	-0.033***	0.054	-0.002
	(0.013)	(0.137)	(0.014)
Foreign ownership Y/N	-0.008	0.037	0.007
	(0.014)	(0.157)	(0.014)
Government ownership Y/N	0.052*	1.098**	-0.058
	(0.030)	(0.522)	(0.039)
Establishment has checking or savings account Y/N	0.105***	-0.258	0.003
	(0.016)	(0.170)	(0.014)
Establishment has a line of credit or loan Y/N	0.037***	0.212**	0.005
	(0.009)	(0.095)	(0.010)
Firm experienced losses due to crime Y/N	0.031***	1.399***	0.058***
	(0.010)	(0.191)	(0.011)
GDP per capita (constant 2010 US$)	-0.002	-0.068	-0.075***
	(0.005)	(0.061)	(0.005)
GDP per capita growth (annual %)	0.003**	-0.040**	-0.001
	(0.001)	(0.019)	(0.002)
Log of land area (sq. km)	-0.009***	0.094***	0.021***
	(0.002)	(0.026)	(0.003)
Legal System: Common law	-0.046***	0.011	0.055***
	(0.011)	(0.167)	(0.012)
Service Sector Firm (Y/N)	0.024***	0.028	0.009
	(0.008)	(0.109)	(0.009)
Region (across countries) Fixed Effects	YES	YES	YES
Number of observations	59,816	48,447	42,117

Note: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

Table 3 presents the findings for public procurement quality and innovation. Better public procurement is positively associated with all five proxies for innovation – product innovation, process innovation,

R&D spending, technology licensed from foreign firms, and internationally recognized quality certification. The coefficient of public procurement quality is statistically significant at the 1% level for all types of innovation with the exception of R&D spending, where it is statistically significant at the 5% level. The two other consistent results across all types of innovation is the positive association with firm size and formal training. Large firms and firms providing formal training for their employees tend to be more innovative.

TABLE 3
Public Procurement and Innovation Outcomes

Dependent Variables	Product Innovation Y/N	Process Innovation Y/N	R & D Expenditure Y/N	Technology licensed from foreign firms Y/N	Internationally Recognized Quality Certification Y/N
	Probit (Marginal Effects)				
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.144***	0.219***	0.086**	0.160***	0.133***
	(0.043)	(0.045)	(0.035)	(0.048)	(0.036)
Log of age of firm	0.008	-0.010	-0.009	0.010*	0.020***
	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)
Log of size	0.012***	0.031***	0.027***	0.033***	0.054***
	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
Firm is part of a larger firm Y/N	0.030**	0.036**	0.023**	0.051***	0.067***
	(0.015)	(0.017)	(0.010)	(0.013)	(0.010)
Firm offers formal training Y/N	0.173***	0.153***	0.127***	0.058***	0.106***
	(0.011)	(0.010)	(0.008)	(0.010)	(0.007)
Top manager experience in sector (years)	0.000	0.000	0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Direct exports 10% or more of sales Y/N	0.051***	0.049***	0.059***	0.011	0.075***
	(0.016)	(0.016)	(0.012)	(0.011)	(0.010)
Foreign ownership Y/N	0.052***	0.024	0.017	0.083***	0.074***
	(0.019)	(0.018)	(0.014)	(0.013)	(0.011)
Government ownership Y/N	0.021	0.050	0.042	-0.040	0.090***
	(0.038)	(0.037)	(0.027)	(0.043)	(0.028)
Establishment has checking or savings account Y/N	0.054***	0.064***	0.033***	0.030**	0.039***
	(0.015)	(0.017)	(0.013)	(0.014)	(0.012)
Establishment has a line of credit or loan Y/N	0.063***	0.072***	0.039***	0.001	-0.003
	(0.011)	(0.011)	(0.008)	(0.011)	(0.008)

TABLE 3 (Continued)

Dependent Variables	Product Innovation Y/N	Process Innovation Y/N	R & D Expenditure Y/N	Technology licensed from foreign firms Y/N	Internationally Recognized Quality Certification Y/N
	Probit (Marginal Effects)				
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
Firm experienced losses due to crime Y/N	0.060***	0.069***	0.051***	-0.005	0.003
	(0.013)	(0.013)	(0.009)	(0.012)	(0.009)
GDP per capita (constant 2010 US$)	-0.017**	-0.044***	0.001	-0.021***	0.021***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.004)
GDP per capita growth (annual %)	-0.007***	-0.004**	-0.004**	0.000	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log of land area (sq. km)	0.009***	0.006**	0.004	-0.004	0.001
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Legal System: Common law	0.008	0.024*	-0.033***	0.005	0.000
	(0.013)	(0.013)	(0.010)	(0.012)	(0.010)
Service Sector Firm (Y/N)	-0.057***	-0.057***	-0.028***		-0.024***
	(0.010)	(0.010)	(0.008)		(0.007)
Region (across countries) Fixed Effects	YES	YES	YES	YES	YES
Number of observations	51,838	50,608	50,851	34,706	60,178

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions. Coef = coefficients; SE = standard errors.

Findings for the relationship between public procurement quality and online engagement are provided in Table 4. Better quality of public procurement is associated with a higher probability of firms engaging suppliers through email, and having their own website. For both measures, the coefficient of public procurement quality is statistically significant at the 1% level. The implication may be that public procurement encourages online engagement through online procurement portals thereby encouraging firms to be more engaged online.

Public procurement may have heterogenous effects in the private sector conditional on the size of the firm. Small and large firms may react differently to the quality of the public procurement system. Thus, we split the sample into two: Small and Medium (SME) size firms

TABLE 4
Public Procurement and Internet Use

Dependent Variables	Firms use email to interact with clients/ suppliers Y/N	Establishment has its own website Y/N
	Probit (Marginal Effects)	
	Coef/Se	Coef/Se
PP Overall Index	0.263***	0.194***
	(0.036)	(0.043)
Log of age of firm	-0.016***	0.009
	(0.006)	(0.007)
Log of size	0.088***	0.093***
	(0.004)	(0.004)
Firm is part of a larger firm Y/N	0.052***	0.087***
	(0.012)	(0.013)
Firm offers formal training Y/N	0.118***	0.140***
	(0.009)	(0.009)
Top manager experience in sector (years)	0.002***	0.001*
	(0.000)	(0.000)
Direct exports 10% or more of sales Y/N	0.125***	0.119***
	(0.016)	(0.014)
Foreign ownership Y/N	0.053***	0.055***
	(0.014)	(0.015)
Government ownership Y/N	-0.068*	-0.059*
	(0.037)	(0.035)
Establishment has checking or savings account Y/N	0.171***	0.152***
	(0.010)	(0.015)
Establishment has a line of credit or loan Y/N	0.083***	0.052***
	(0.009)	(0.010)
Firm experienced losses due to crime Y/N	-0.009	-0.005
	(0.010)	(0.011)
GDP per capita (constant 2010 US$)	0.037***	0.049***
	(0.004)	(0.005)
GDP per capita growth (annual %)	-0.006***	-0.003*
	(0.002)	(0.002)
Log of land area (sq. km)	0.001	0.013***
	(0.003)	(0.003)
Legal System: Common law	-0.025***	-0.049***
	(0.009)	(0.012)
Service Sector Firm (Y/N)	0.038***	0.044***
	(0.007)	(0.008)
Region (across countries) Fixed Effects	YES	YES
Number of observations	61,518	61,494

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented.

(5 to 99 full time employees) and large firms (100 plus full-time employees). We repeat the estimations separately for each group. The results for Table 2 split by small and large firms and provided in Table 5. Public procurement leads to greater participation of firms in public procurement, lowers corruption, and reduces losses from domestic shipping regardless of firm size. The coefficient of public procurement statistically significant, at least at the 10 percent level.

TABLE 5
Public Procurement and Participation, Infrastructure and Corruption by Firm Size

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N		Products Lost to Breakage or Spoi-lage during Shipping in Domestic Markets (%)		Experienced at least one Bribe Payment Y/N	
	Probit (Marginal Effects)		OLS		Probit (Marginal Effects)	
	SME	Large	SME	Large	SME	Large
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.121***	0.259**	-1.072**	-1.351*	-0.173***	-0.237**
	(0.041)	(0.103)	(0.469)	(0.694)	(0.045)	(0.108)
Log of age of firm	-0.017***	0.019	-0.024	0.047	-0.000	-0.005
	(0.006)	(0.016)	(0.070)	(0.063)	(0.008)	(0.013)
Log of size	0.035***	0.012	-0.154**	-0.167	0.016**	-0.013
	(0.005)	(0.013)	(0.066)	(0.102)	(0.006)	(0.012)
Firm is part of a larger firm Y/N	-0.020	-0.030	-0.220	0.410*	-0.001	0.043*
	(0.015)	(0.025)	(0.164)	(0.227)	(0.016)	(0.025)
Firm offers formal training Y/N	0.075***	0.051*	0.231	0.195	0.002	-0.014
	(0.010)	(0.026)	(0.148)	(0.205)	(0.011)	(0.025)
Top manager experience in sector (years)	0.002***	0.002***	-0.003	-0.014**	-0.002***	-0.001
	(0.000)	(0.001)	(0.005)	(0.006)	(0.001)	(0.001)
Direct exports 10% or more of sales Y/N	-0.016	-0.108***	0.067	-0.066	-0.001	0.006
	(0.014)	(0.024)	(0.163)	(0.160)	(0.017)	(0.023)
Foreign ownership Y/N	-0.009	0.018	0.033	0.069	0.016	-0.018
	(0.016)	(0.027)	(0.192)	(0.171)	(0.016)	(0.028)
Government ownership Y/N	0.033	0.115***	1.430***	0.239	-0.043	-0.097**
	(0.042)	(0.044)	(0.368)	(0.250)	(0.049)	(0.044)
Establishment has checking or savings account Y/N	0.102***	0.108***	-0.223	-1.218**	0.000	0.026
	(0.016)	(0.038)	(0.177)	(0.545)	(0.015)	(0.059)
Establishment has a line of credit or loan Y/N	0.035***	0.049**	0.214**	0.206	0.006	0.001
	(0.009)	(0.024)	(0.104)	(0.161)	(0.011)	(0.022)

TABLE 5 (Continued)

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N		Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)		Experienced at least one Bribe Payment Y/N	
	Probit (Marginal Effects)		OLS		Probit (Marginal Effects)	
	SME	Large	SME	Large	SME	Large
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
Firm experienced losses due to crime Y/N	0.032***	0.029	1.476***	0.812***	0.057***	0.077***
	(0.011)	(0.026)	(0.216)	(0.227)	(0.012)	(0.024)
GDP per capita (constant 2010 US$)	-0.003	-0.002	-0.052	-0.203	-0.075***	-0.076***
	(0.005)	(0.015)	(0.066)	(0.128)	(0.006)	(0.015)
GDP per capita growth (annual %)	0.003**	0.007**	-0.038*	-0.057	-0.002	0.000
	(0.002)	(0.004)	(0.021)	(0.036)	(0.002)	(0.004)
Log of land area (sq. km)	-0.009***	-0.008	0.096***	0.084*	0.021***	0.016***
	(0.003)	(0.007)	(0.029)	(0.043)	(0.003)	(0.006)
Legal System: Common law	-0.047***	-0.008	-0.070	0.842**	0.059***	-0.012
	(0.011)	(0.033)	(0.184)	(0.378)	(0.013)	(0.035)
Service Sector Firm (Y/N)	0.017**	0.105***	0.031	0.114	0.005	0.049**
	(0.008)	(0.021)	(0.119)	(0.162)	(0.010)	(0.023)
Region (across countries) Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	48,066	11,750	38,681	9,766	32,823	9,294

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

In Table 6 we repeat the estimations in Table 3 by SME and large firms. Public procurement quality encourages process innovation, R&D spending and internationally recognized quality certification regardless of firm size. However, for product innovation and technology licensed from foreign firms, the coefficient of public procurement is statistically significant only for SMEs. The implication may be that the quality of public procurement has a greater influence in the incidence of production innovation and foreign technology among SMEs than large firms. In Table 7 we

TABLE 6
Public Procurement and Innovation by Firm Size

Independent Variable	Prod Innov		Proc Innov		R & D		Tech. Lic. FF		IRQC	
	Probit (Marginal Effects)									
	SME	Large	SME	Large	SME	Large	SME	Large	SME	Large
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.150***	0.112	0.221***	0.245**	0.077**	0.228*	0.162***	0.021	0.133***	0.214*
	(0.046)	(0.136)	(0.048)	(0.120)	(0.036)	(0.130)	(0.050)	(0.152)	(0.038)	(0.126)
Log of age of firm	0.008	0.015	-0.013	0.023	-0.012*	0.019	0.012*	-0.004	0.014**	0.080***
	(0.009)	(0.019)	(0.008)	(0.018)	(0.006)	(0.016)	(0.007)	(0.017)	(0.006)	(0.018)
Log of size	0.022***	-0.027*	0.041***	0.003	0.028***	0.032**	0.035***	0.043***	0.056***	0.028*
	(0.007)	(0.015)	(0.006)	(0.015)	(0.005)	(0.015)	(0.006)	(0.014)	(0.005)	(0.016)
Firm is part of a larger firm Y/N	0.019	0.111***	0.040**	0.024	0.030***	0.003	0.053***	0.044	0.072***	0.061*
	(0.017)	(0.029)	(0.020)	(0.031)	(0.012)	(0.032)	(0.016)	(0.029)	(0.011)	(0.034)
Firm offers formal training Y/N	0.176***	0.137***	0.149***	0.176***	0.116***	0.232***	0.049***	0.133***	0.100***	0.160***
	(0.012)	(0.029)	(0.011)	(0.028)	(0.008)	(0.025)	(0.012)	(0.028)	(0.008)	(0.026)
Top manager experience in sector (years)	-0.000	0.002*	0.000	-0.001	0.001	0.000	-0.000	-0.001	0.000	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Direct exports 10% or more of sales Y/N	0.062***	0.014	0.055***	0.028	0.062***	0.041	0.010	0.006	0.064***	0.174***
	(0.019)	(0.031)	(0.019)	(0.028)	(0.013)	(0.027)	(0.013)	(0.026)	(0.011)	(0.031)
Foreign ownership Y/N	0.052**	0.074**	0.031	0.010	0.029*	-0.060*	0.078***	0.123***	0.074***	0.101***
	(0.022)	(0.037)	(0.021)	(0.034)	(0.016)	(0.032)	(0.014)	(0.029)	(0.012)	(0.031)
Government ownership Y/N	0.014	0.048	0.041	0.076	0.057*	0.004	-0.004	-0.108*	0.098***	0.067
	(0.049)	(0.057)	(0.048)	(0.059)	(0.032)	(0.054)	(0.057)	(0.064)	(0.033)	(0.060)
Establishment has checking or savings account Y/N	0.056***	-0.043	0.061***	0.077*	0.030**	0.047	0.027*	0.019	0.035***	0.086
	(0.016)	(0.051)	(0.018)	(0.042)	(0.013)	(0.048)	(0.014)	(0.050)	(0.012)	(0.055)

TABLE 6 (Continued)

	Product Innovation		Process Innovation		R & D		Tech. Lic. FF		IRQC	
	Probit (Marginal Effects)									
	SME	Large	SME	Large	SME	Large	SME	Large	SME	Large
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
Establishment has a line of credit or loan Y/N	0.056***	0.122***	0.070***	0.082***	0.040***	0.011	0.010	-0.066**	-0.007	0.041
	(0.012)	(0.026)	(0.012)	(0.025)	(0.008)	(0.024)	(0.012)	(0.026)	(0.008)	(0.030)
Firm experienced losses due to crime Y/N	0.057***	0.089***	0.069***	0.078**	0.049***	0.075**	-0.004	-0.005	0.008	-0.028
	(0.014)	(0.032)	(0.014)	(0.031)	(0.009)	(0.030)	(0.013)	(0.030)	(0.010)	(0.029)
GDP per capita (constant 2010 US$)	-0.013*	-0.059***	-0.043***	-0.059***	0.003	-0.009	-0.020***	-0.022	0.020***	0.042**
	(0.007)	(0.020)	(0.008)	(0.016)	(0.006)	(0.020)	(0.007)	(0.017)	(0.005)	(0.019)
GDP per capita growth (annual %)	-0.008***	-0.001	-0.005**	0.002	-0.004***	0.006	-0.000	0.001	-0.003*	0.002
	(0.002)	(0.005)	(0.002)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.004)
Log of land area (sq. km)	0.007**	0.026***	0.006*	0.005	0.004	-0.001	-0.004	-0.011	-0.000	0.010
	(0.003)	(0.009)	(0.003)	(0.008)	(0.003)	(0.008)	(0.003)	(0.008)	(0.003)	(0.007)
Legal System: Common law	0.002	0.087*	0.024*	0.022	-0.031***	-0.028	-0.005	0.085**	-0.002	0.027
	(0.014)	(0.046)	(0.013)	(0.043)	(0.010)	(0.042)	(0.013)	(0.037)	(0.010)	(0.038)
Service Sector Firm (Y/N)	-0.061***	-0.017	-0.055***	-0.068**	-0.025***	-0.075***			-0.018**	-0.065**
	(0.011)	(0.032)	(0.011)	(0.030)	(0.008)	(0.028)			(0.007)	(0.028)
Region (across countries) Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	41,587	10,251	40,654	9,954	40,861	9,990	26,297	8,409	48,558	11,620

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.
Legends: Tech. Lic. FFF = Technology licensed from foreign firms; IRQC = Internationally Recognized Quality Certification

TABLE 7
Public Procurement and Internet Use by Firm Size

Independent Variables	Firms use email to interact with clients/suppliers Y/N		Establishment has its own website Y/N	
	Probit (Marginal Effects)			
	SME	Large	SME	Large
	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.279***	0.076*	0.193***	0.213**
	(0.039)	(0.046)	(0.047)	(0.106)
Log of age of firm	-0.019***	0.009	0.005	0.043***
	(0.006)	(0.006)	(0.007)	(0.016)
Log of size	0.100***	0.025***	0.105***	0.071***
	(0.005)	(0.009)	(0.006)	(0.017)
Firm is part of a larger firm Y/N	0.061***	-0.005	0.097***	0.027
	(0.014)	(0.014)	(0.015)	(0.029)
Firm offers formal training Y/N	0.121***	0.062***	0.139***	0.141***
	(0.010)	(0.011)	(0.010)	(0.023)
Top manager experience in sector (years)	0.003***	0.001**	0.001**	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Direct exports 10% or more of sales Y/N	0.136***	0.026*	0.128***	0.076***
	(0.018)	(0.014)	(0.016)	(0.026)
Foreign ownership Y/N	0.054***	0.034**	0.057***	0.057*
	(0.016)	(0.013)	(0.017)	(0.029)
Government ownership Y/N	-0.075	-0.010	-0.078*	0.008
	(0.046)	(0.019)	(0.044)	(0.043)
Establishment has checking or savings account Y/N	0.177***	0.068***	0.152***	0.104***
	(0.011)	(0.014)	(0.016)	(0.036)
Establishment has a line of credit or loan Y/N	0.089***	0.015	0.050***	0.058**
	(0.010)	(0.010)	(0.011)	(0.027)
Firm experienced losses due to crime Y/N	-0.008	-0.009	-0.003	-0.018
	(0.011)	(0.013)	(0.012)	(0.027)
GDP per capita (constant 2010 US$)	0.039***	0.010	0.051***	0.016
	(0.005)	(0.006)	(0.006)	(0.016)
GDP per capita growth (annual %)	-0.006***	-0.001	-0.003	-0.006
	(0.002)	(0.002)	(0.002)	(0.004)
Log of land area (sq. km)	0.001	-0.003	0.012***	0.023***
	(0.003)	(0.003)	(0.003)	(0.007)
Legal System: Common law	-0.028***	0.016	-0.053***	0.010
	(0.010)	(0.014)	(0.013)	(0.031)
Service Sector Firm (Y/N)	0.042***	0.001	0.043***	0.065***
	(0.008)	(0.010)	(0.009)	(0.024)
Region (across countries) Fixed Effects	YES	YES	YES	YES
Number of observations	49,565	11,953	49,543	11,951

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

repeat the estimations of Table 4 by SME and large firms. The quality of public procurement has a positive effect on the probability of a firm having its own website or engaging with clients or suppliers via email regardless of firm size. The findings are statistically significant at least at the 10 percent level.

Finally, we explore the relationship between public procurement quality and firm outcomes by sector – manufacturing versus services firms. Table 8 repeats the results of Table 2 by sector. Public procurement quality increases firm participation in public procurement and reduces corruption regardless of whether the firm is in the manufacturing or service sector. However, the negative association between public procurement quality and products lost in domestic shipping is only statistically significant for manufacturing firms. This finding could be because manufacturing firms are more likely to ship larger amounts of goods domestically.

TABLE 8
Public Procurement and Internet Use by Firm Sector

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N		Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)		Experienced at least one Bribe Payment Y/N	
	Probit (Marginal Effects)		OLS		Probit (Marginal Effects)	
	Manufac-turing	Services	Manufac-turing	Services	Manufac-turing	Services
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.132**	0.125**	-0.937*	-0.992	-0.127*	-0.194***
	(0.054)	(0.055)	(0.507)	(0.656)	(0.068)	(0.054)
Log of age of firm	0.003	-0.023***	-0.026	-0.024	-0.004	0.000
	(0.008)	(0.008)	(0.072)	(0.104)	(0.010)	(0.010)
Log of size	0.006	0.036***	-0.156***	-0.150*	-0.002	0.014**
	(0.005)	(0.005)	(0.048)	(0.079)	(0.006)	(0.006)
Firm is part of a larger firm Y/N	0.011	-0.038**	0.058	-0.202	0.021	-0.001
	(0.015)	(0.018)	(0.173)	(0.221)	(0.022)	(0.018)
Firm offers formal training Y/N	0.055***	0.083***	0.229*	0.227	0.018	-0.006
	(0.011)	(0.013)	(0.124)	(0.227)	(0.015)	(0.014)
Top manager experience in sector (years)	0.001**	0.003***	-0.010*	0.002	-0.001*	-0.002**
	(0.001)	(0.001)	(0.005)	(0.008)	(0.001)	(0.001)
Direct exports 10% or more of sales Y/N	-0.039***	-0.018	-0.281**	0.417	0.006	-0.007
	(0.014)	(0.021)	(0.125)	(0.281)	(0.016)	(0.024)

TABLE 8 (Continued)

Dependent Variables	Government Contract Secured or Attempted in the last 12 months Y/N		Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)		Experienced at least one Bribe Payment Y/N	
	Probit (Marginal Effects)		OLS		Probit (Marginal Effects)	
	Manufac-turing	Services	Manufac-turing	Services	Manufac-turing	Services
	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se	Coef/Se
Foreign ownership Y/N	-0.008	-0.009	0.218	-0.087	0.019	0.002
	(0.019)	(0.019)	(0.257)	(0.209)	(0.021)	(0.020)
Government ownership Y/N	0.068**	0.050	0.961	1.154	-0.053	-0.057
	(0.034)	(0.047)	(0.743)	(0.749)	(0.048)	(0.057)
Establishment has checking or savings account Y/N	0.095***	0.112***	-0.337	-0.224	-0.030	0.021
	(0.019)	(0.023)	(0.244)	(0.232)	(0.022)	(0.019)
Establishment has a line of credit or loan Y/N	0.052***	0.030**	0.033	0.339**	0.001	0.008
	(0.012)	(0.012)	(0.115)	(0.155)	(0.014)	(0.014)
Firm experienced losses due to crime Y/N	0.063***	0.017	0.953***	1.795***	0.076***	0.049***
	(0.014)	(0.014)	(0.169)	(0.350)	(0.017)	(0.015)
GDP per capita (constant 2010 US$)	-0.014**	0.004	-0.081	-0.052	-0.069***	-0.078***
	(0.006)	(0.007)	(0.091)	(0.103)	(0.008)	(0.007)
GDP per capita growth (annual %)	0.002	0.003*	-0.021	-0.038	-0.000	-0.003
	(0.002)	(0.002)	(0.023)	(0.033)	(0.002)	(0.003)
Log of land area (sq. km)	-0.005	-0.011***	0.037	0.122***	0.016***	0.023***
	(0.003)	(0.003)	(0.030)	(0.038)	(0.004)	(0.004)
Legal System: Common law	-0.026*	-0.054***	0.271	-0.159	0.074***	0.046***
	(0.014)	(0.015)	(0.176)	(0.294)	(0.016)	(0.016)
Constant			2.769***	1.198		
			(0.942)	(0.811)		
Region (across countries) Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	35,105	24,711	31,873	16,574	24,297	17,820

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

The findings for innovation by sector are presented in Table 9. Note that adoption of technology licensed from foreign firms is omitted as the survey question was only asked of manufacturing firms. The findings indicate that public procurement quality has a positive influence on product innovation, process innovation and R&D

TABLE 9
Public Procurement and Internet Use by Firm Sector

Dependent Variables	Product Innovation Y/N		Process Innovation Y/N		R & D Expenditure		Internationally Recognized Quality Certification Y/N	
	Probit (Marginal Effects)							
	Manf.	Services	Manf.	Services	Manf.	Services	Manf.	Services
	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
PP Overall Index	0.168**	0.101	0.395***	0.040	0.180***	-0.006	0.101**	0.144***
	(0.068)	(0.062)	(0.062)	(0.071)	(0.054)	(0.050)	(0.051)	(0.049)
Log of age of firm	0.008	0.010	-0.002	-0.014	-0.007	-0.009	0.028***	0.017**
	(0.010)	(0.012)	(0.009)	(0.012)	(0.007)	(0.009)	(0.007)	(0.008)
Log of size	0.006	0.020***	0.028***	0.035***	0.032***	0.023***	0.065***	0.048***
	(0.006)	(0.007)	(0.005)	(0.007)	(0.004)	(0.005)	(0.004)	(0.004)
Firm is part of a larger firm Y/N	0.044*	0.022	0.060***	0.019	0.030*	0.018	0.075***	0.065***
	(0.023)	(0.021)	(0.019)	(0.027)	(0.016)	(0.015)	(0.015)	(0.013)
Firm offers formal training Y/N	0.141***	0.189***	0.151***	0.150***	0.153***	0.111***	0.109***	0.105***
	(0.016)	(0.015)	(0.014)	(0.015)	(0.011)	(0.011)	(0.010)	(0.010)
Top manager experience in sector (years)	0.001	-0.001	0.001	-0.001	0.001**	-0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Direct exports 10% or more of sales Y/N	0.068***	0.039	0.050***	0.053*	0.066***	0.046**	0.084***	0.062***
	(0.018)	(0.030)	(0.017)	(0.030)	(0.013)	(0.021)	(0.013)	(0.017)
Foreign ownership Y/N	0.009	0.074***	0.015	0.023	0.017	0.015	0.087***	0.067***
	(0.025)	(0.027)	(0.022)	(0.028)	(0.020)	(0.021)	(0.016)	(0.015)
Government ownership Y/N	0.048	0.003	0.099*	0.026	0.025	0.048	0.027	0.115***
	(0.060)	(0.053)	(0.054)	(0.052)	(0.036)	(0.035)	(0.031)	(0.038)

TABLE 9 (Continued)

Dependent Variables	Product Innovation Y/N		Process Innovation Y/N		R & D Expenditure		Internationally Recognized Quality Certification Y/N	
	Probit (Marginal Effects)							
	Manf.	Services	Manf.	Services	Manf.	Services	Manf.	Services
	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Establishment has checking or savings account Y/N	0.105***	0.029	0.071***	0.064**	0.082***	0.011	0.020	0.047***
	(0.023)	(0.021)	(0.025)	(0.026)	(0.020)	(0.016)	(0.018)	(0.016)
Establishment has a line of credit or loan Y/N	0.080***	0.051***	0.078***	0.065***	0.064***	0.019*	0.014	-0.011
	(0.015)	(0.017)	(0.014)	(0.016)	(0.011)	(0.012)	(0.010)	(0.011)
Firm experienced losses due to crime Y/N	0.067***	0.057***	0.054***	0.074***	0.058***	0.046***	-0.003	0.007
	(0.020)	(0.018)	(0.019)	(0.018)	(0.014)	(0.013)	(0.013)	(0.012)
GDP per capita (constant 2010 US$)	-0.005	-0.021**	-0.039***	-0.044***	0.010	-0.001	0.028***	0.018***
	(0.010)	(0.009)	(0.010)	(0.011)	(0.008)	(0.007)	(0.005)	(0.006)
GDP per capita growth (annual %)	-0.003	-0.011***	-0.001	-0.008**	-0.001	0.006***	-0.003*	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Log of land area (sq. km)	0.011**	0.006	0.013***	-0.005	0.011***	-0.003	0.012***	-0.004
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)
Legal System: Common law	0.002	0.028	-0.008	0.056***	0.009	-0.033**	-0.003	-0.004
	(0.020)	(0.018)	(0.017)	(0.018)	(0.017)	(0.013)	(0.012)	(0.014)
Region (across countries) Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	32,129	19,709	31,942	18,666	32,052	18,799	35,099	25,079

Notes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

spending for manufacturing firms, but no statistically significant effect for service firms. However, public procurement quality has a positive relationship with the presence of internationally recognized quality certification for both manufacturing and service firms. The data seems to indicate that in terms of innovation, the quality of public procurement has a far greater effect on manufacturing firms than services firms. With regards to online engagement, as reported in Table 10, public procurement quality has a positive coefficient regardless of the sector of the firm.

VI. CONCLUSION

Good quality public procurement systems may have direct and indirect effects on private businesses. They can generate a domino effect by raising certain aspects of firms that may lead to productivity increases. In this study, through two unique datasets, we find strong positive correlations between good public procurement systems and firm engagement, infrastructure quality, innovation and online

TABLE 10
Public Procurement and Internet Use by Firm Sector

Dependent Variables	Firms use email to interact with clients/suppliers Y/N		Establishment has its own website Y/N	
	Model: Probit (Marginal Effects): coef/se			
	Manufac-turing	Services	Manufac-turing	Services
	Coef/Se	Coef/Se	Coef/Se	Coef/Se
PP Overall Index	0.250***	0.239***	0.290***	0.141**
	(0.046)	(0.051)	(0.053)	(0.061)
Log of age of firm	-0.020***	-0.015*	0.024***	0.001
	(0.007)	(0.008)	(0.008)	(0.010)
Log of size	0.094***	0.084***	0.087***	0.096***
	(0.005)	(0.006)	(0.005)	(0.006)
Firm is part of a larger firm Y/N	0.051***	0.053***	0.084***	0.090***
	(0.017)	(0.017)	(0.020)	(0.019)
Firm offers formal training Y/N	0.114***	0.119***	0.120***	0.150***
	(0.012)	(0.012)	(0.012)	(0.013)
Top manager experience in sector (years)	0.002***	0.003***	0.000	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Direct exports 10% or more of sales Y/N	0.121***	0.120***	0.127***	0.107***
	(0.019)	(0.025)	(0.015)	(0.024)

TABLE 10 (Continued)

Dependent Variables	Firms use email to interact with clients/suppliers Y/N		Establishment has its own website Y/N	
	Model: Probit (Marginal Effects): coef/se			
	Manufac-turing	Services	Manufac-turing	Services
	Coef/Se	Coef/Se	Coef/Se	Coef/Se
Foreign ownership Y/N	0.041**	0.058***	0.028	0.069***
	(0.020)	(0.019)	(0.020)	(0.022)
Government ownership Y/N	-0.094***	-0.059	-0.058	-0.062
	(0.035)	(0.055)	(0.042)	(0.051)
Establishment has checking or savings account Y/N	0.159***	0.178***	0.135***	0.163***
	(0.015)	(0.014)	(0.021)	(0.020)
Establishment has a line of credit or loan Y/N	0.062***	0.089***	0.045***	0.052***
	(0.011)	(0.013)	(0.012)	(0.015)
Firm experienced losses due to crime Y/N	-0.001	-0.012	-0.011	0.002
	(0.015)	(0.014)	(0.015)	(0.016)
GDP per capita (constant 2010 US$)	0.045***	0.033***	0.046***	0.049***
	(0.006)	(0.006)	(0.006)	(0.008)
GDP per capita growth (annual %)	-0.010***	-0.004*	-0.001	-0.004*
	(0.002)	(0.002)	(0.002)	(0.003)
Log of land area (sq. km)	0.007**	-0.004	0.019***	0.009**
	(0.003)	(0.004)	(0.003)	(0.004)
Legal System: Common law	0.044***	-0.057***	-0.006	-0.074***
	(0.012)	(0.013)	(0.014)	(0.017)
Region (across countries) Fixed Effects	YES	YES	YES	YES
Number of observations	35,890	25,628	35,868	25,626

Motes: *** p<0.01, ** p<0.05, * p<0.1. Marginal effects presented, constant included in all regressions.

connectivity. Good procurement systems are negatively correlated with corruption faced by the business sector. Given that public procurement is sizeable in many economies, and its effects may be multifaceted, reforming public procurement systems is an important endeavor to improve the business environment in the economy.

This study does have limitations. It is difficulty to argue for causality given the data at hand. It is not possible to disentangle the direction of causality in many of the estimations. While the current study is rich in terms of country coverage, and detailed in terms of the wealth of information on firms, future studies may adopt a less holistic approach and explore exogenous changes in aspects of public procurement systems. This could allow for some specific causal statements that would complement the current study.

NOTES

1. The findings, interpretations and conclusions expressed herein are those of the authors and do not necessarily reflect the view of the World Bank Group, its Board of Directors or the governments they represent.
2. Details of the ES methodology and coverage can be found in the Enterprise Surveys website http://www.enterprisesurveys.org.

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APPENDIX A
Country List

Afghanistan	Djibouti	Madagascar	Sierra Leone
Albania	Dominica	Malawi	Slovak Republic
Angola	Ecuador	Malaysia	Slovenia
Antigua and Barbuda	Egypt, Arab Rep.	Mauritania	Solomon Islands

APPENDIX A (Continued)

Argentina	Eritrea	Mauritius	South Africa
Armenia	Estonia	Mexico	Sri Lanka
Azerbaijan	Ethiopia	Micronesia, Fed. Sts.	St. Kitts and Nevis
Bahamas, The	Macedonia, FYR	Moldova	St. Lucia
Bangladesh	Gabon	Mongolia	Sudan
Barbados	Georgia	Montenegro	Suriname
Belarus	Ghana	Morocco	Tajikistan
Belize	Grenada	Mozambique	Tanzania
Bolivia	Guatemala	Namibia	Tonga
Bosnia & Herzegovina	Honduras	Nepal	Trinidad and Tobago
Botswana	Hungary	Nicaragua	Tunisia
Brazil	India	Niger	Turkey
Bulgaria	Indonesia	Nigeria	Uganda
Burkina Faso	Iraq	Pakistan	Ukraine
Burundi	Israel	Panama	Uruguay
Cabo Verde	Jamaica	Paraguay	Uzbekistan
Central African Republic	Jordan	Peru	Vanuatu
Chad	Kazakhstan	Philippines	Venezuela, RB
Chile	Kenya	Poland	Vietnam
China	Kyrgyz Republic	Russian Federation	Yemen, Rep.
Colombia	Latvia	Rwanda	Zambia
Costa Rica	Lebanon	Samoa	
Croatia	Liberia	Senegal	
Czech Republic	Lithuania	Serbia	

APPENDIX B
Variable Descriptions

Variable	Description	Source
Government Contract Secured or Attempted in the last 12 months Y/N	Self explanatory	World Bank (WB) Enterprise Surveys Surveys
Products Lost to Breakage or Spoilage during Shipping in Domestic Markets (%)	Self explanatory	WB Enterprise Surveys
Experienced at least one Bribe Payment Y/N	Dummy variable equal to 1 if firm experienced at least one bribe payment request across 6 public transactions dealing with utilities access, permits, licenses, and taxes. Dummy variable is equal to 0 otherwise.	WB Enterprise Surveys

APPENDIX B (Continued)

Variable	Description	Sources
Product Innovation Y/N	Response to the survey question "during the last three years, has this establishment introduced new or significantly improved products or services?"	WB Enterprise Surveys
Process Innovation Y/N	Response to the survey question "during the last three years, has this establishment introduced any new or significantly improved process? These include: methods of manufacturing products or offering services; logistics, delivery, or distribution methods for inputs, products, or services; or supporting activities for processes."	WB Enterprise Surveys
R & D Expenditure Y/N	Response to the survey question "during last fiscal year, did this establishment spend on formal research and development activities, either in-house or contracted with other companies, excluding market research surveys?"	WB Enterprise Surveys
Technology licensed from foreign firms Y/N	Self explanatory. Only asked of manufacturing firms.	WB Enterprise Surveys
internationally recognized quality certification Y/N	Response to the survey question "does this establishment have an internationally-recognized quality certification?" Examples include ISO 9000 or 14000, or HAPC.	WB Enterprise Surveys
Firm Uses email to Interact with clients /suppliers Y/N	Self explanatory	WB Enterprise Surveys
Establishment has its own website Y/N	Self explanatory	WB Enterprise Surveys
PP Overall Index	Procurement life cycle overall score - average of scores of 3 sub- categories defined below - (i) bid preparation, (ii) bid and contract management, and (iii) payment of suppliers score	Djankov et al., 2017
Bid Preparation Score	Explores elements that form part of the bid preparation phase, such as the existence of procurement portals, the cost and accessibility of relevant information, and the openness and transparency on how this preparation phase is conducted.	Djankov et al., 2017
Bid and Contract Management Score	Combination of the following elements of procurement: Bid submission, bid opening, evaluation and award, and the content and management of procurement contract. Bid submission measures the ease of submitting bids, including the procedures and costs involved in the process and the availability of electronic means to	Djankov et al., 2017

APPENDIX B (Continued)

Variable	Description	Sources
	submit the bids. It also measures that the legal framework provides a minimum time to submit the bids and regulates the amount of bid securities. Bid opening, evaluation, and award assesses whether the bid opening, evaluation and contract award are conducted through an open and fair process in order to guarantee bidders that the process follows the best standards of transparency and that losing bidders are timely informed on the procuring entity's decision. Content and management of procurement contract examines the procedures involved during the execution of the contract until its completion or its termination. It also examines the existence of controls regarding modifications of the contract, including communicating those variations to other interested parties.	
Payment of Suppliers Score	Examines whether the legal framework regulates the payment of suppliers. It also assess the time needed for the purchasing entity to start processing the payment once the invoice is submitted as well as the time in practice for suppliers to obtain payment once they submit their invoice. It also examines whether interests/penalties are paid in case of payment delays, whether they are automatic and the method for determining them	Djankov et al., 2017
Log of age of firm	Self explanatory	WB Enterprise Surveys
Log of size	Log of the size of the firm in terms of total full time employment	WB Enterprise Surveys
Firm is part of a larger firm Y/N	Dummy variable equal to 1 if the firm is part of a larger firm, 0 otherwise	WB Enterprise Surveys
Firm offers formal training Y/N	Dummy variable equal to 1 if the firm offers formal training, 0 otherwise	WB Enterprise Surveys
Top manager experience in sector (years)	Self explanatory	WB Enterprise Surveys
Direct exports 10% or more of sales Y/N	Self explanatory	WB Enterprise Surveys

APPENDIX B (Continued)

Variable	Description	Sources
Foreign ownership Y/N	Dummy variable equal to 1 if the firm has foreign has foreign owners, 0 otherwise	WB Enterprise Surveys
Establishment has checking or savings account Y/N	Self explanatory	WB Enterprise Surveys
Establishment has a line of credit or loan Y/N	Self explanatory	WB Enterprise Surveys
Firm experienced losses due to crime Y/N	Self explanatory	WB Enterprise Surveys
Service Sector Firm (Y/N)	Dummy variable equal to 1 if the firm is in the service sector, 0 otherwise	WB Enterprise Surveys
Log of land area (sq. km)	Self explanatory	WB, World Development Indicators
Legal System: Common law	Dummy variable equal to 1 if country has common law or mixed legal system	Authors' calculations
GDP per capita (constant 2010 US$)	GDP per capita (constant 2005 US$). Data are in constant 2005 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2005 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.	WB, World Development Indicators
GDP per capita growth (annual %)	Annual percentage growth rate of GDP per capita based on constant local currency.	WB, World Development Indicators