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procurement: Evidence from Sub-Saharan Africa

Bernard Hoekman and Marco Sanfilippo

European University Institute

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Abstract

This paper exploits a firm-level dataset for nineteen Sub-Saharan African countries that provides information on the share of total sales to government entities to provide new insights into the relative importance of participation in public procurement activity for different types of firms. We investigate whether participation in public procurement is associated with realization of the types of goals that underlie industrial policy – an improvement in measures of firm performance – and find that firms that sell a larger share of their output to government entities have better productivity performance. This is most strongly the case for domestically-owned firms, especially small companies, firms engaged in manufacturing activities and those located in the capital city. A positive relationship between participation in public procurement and performance is not observed for foreign-owned firms or companies that are in the service sector.

Keywords

Firm performance; productivity; government demand; public procurement; industrial policy; Sub-Saharan Africa

JEL Classification: H57; O12

1. Introduction*

Governments around the world purchase a large variety of products from the private sector in order to provide public goods and services to citizens. Such public procurement often accounts for a significant share of GDP and thus aggregate demand. In low-income countries public procurement constitutes 14.4 percent of GDP on average, with even larger values recorded in some of the poorest regions of the world, including South Asia and Sub-Saharan Africa (Djankov et al., 2016; World Bank, 2016). Given the magnitude of government expenditures on goods and services, public procurement systems incorporate procedures that aim to ensure that contracts are awarded to the lowest cost suppliers that satisfy the technical specifications that need to be met. In most countries, if not all, value for money is not the only goal of public procurement systems. Governments also use procurement to pursue distributional, growth or industrial development goals (Geroski, 1990; Evenett and Hoekman, 2005; Kattel and Veiko, 2010). This may be reflected in quotas or price preferences for certain categories of domestic firms – e.g., minority-owned; small; located in disadvantaged regions; etc. – and more generally processes that earmark government funds for domestic firms (“buy national” policies).

Public procurement has been a key tool in the industrial policy mix of many countries seeking to upgrade their industrial capabilities, encourage innovation and attain sustainable development goals – e.g., through so-called green procurement (OECD, 2013; Rodrik, 2015; UNIDO, 2017). There are good arguments why targeting procurement to create demand for new or innovative technologies may help complement supply side policies such as R&D subsidies. Geroski (1990) notes that government demand can stimulate innovation and allow firms to learn by doing. Price preference policies for domestic firms, local content or technology transfer requirements for foreign bidders may help foster innovation and learning, and more generally enhance the competitiveness of the domestic private sector (OECD, 2013; Ribiero and Furtado, 2014; Altenburg and Lütkenhorst, 2015; Dawar and Oh, 2017). In addition, governments may use procurement as a macroeconomic tool – e.g., through stimulus packages to boost aggregate demand in the aftermath of the global financial crisis (Evenett and Shingal, 2016; Gourdon and Messent, 2017).

There are long-standing debates on the utility and design of industrial policy (e.g., Page and Tarp, 2017). These have tended to neglect the role of public procurement. There is only limited evidence on the extent to which public procurement is actually allocated with a view to achieving industrial development or competitiveness objectives and if so, whether it effectively contributes to the realization of such goals and the extent to which it improves firm-level productivity performance. Most research on the effects of public procurement centres on whether value for money is achieved and the effects of specific procurement procedures and mechanisms – e.g., publication of calls for tender; qualification of bidders; measures to prevent collusion and corruption.¹ Moreover, most of the limited extant research is largely focussed on advanced economies; there is relatively little research on procurement in developing countries. In (large) part, the lack of research reflects the difficulties of accessing information on public procurement contracts and purchasing activities in low-income countries and a lack of disaggregated data on sales by firms that distinguish between different types of buyers.

* We are grateful to Richard Newfarmer and Ritwika Sen for helpful comments on an earlier draft. We thank UNIDO for granting access to the African Investor Survey data. Financial support for this research was provided by the International Growth Centre (Project N. 43421).

¹ For example, Onur et al. (2012) analyse 90,000 government procurement tenders held in Turkey during 2004–06 and find that greater competition associated with open tendering procedures reduces average prices. Tenders that are open to foreign participation further reduce prices paid.

In this paper we use firm-level data from a survey covering roughly 6,700 companies based in 19 Sub-Saharan African (SSA) countries to investigate one dimension of the effect of public procurement. The survey includes information on the share of total sales to the Government. We use this to undertake an empirical assessment of the potential role that Government demand can have as a determinant of firm performance in the countries concerned. To the best of our knowledge this is the first effort to explore empirically the nexus between public procurement and firm performance in a cross-section of low-income countries. The case of SSA is particularly relevant for such an analysis given the presumption that one factor impeding structural transformation is weak demand (McMillan et al., 2014; Newman et al., 2016; UNIDO, 2017). In our sample of firms, a little over one-third report that low demand is a major cause of capacity underutilization. Government procurement can represent a meaningful source of demand, and the allocation of a government contract may encourage incumbent firms to invest more, expand employment and increase productivity (Geroski, 1990; Acemoglu et al., 2013; Ferraz et al., 2015). Such effects may not arise, however, as public procurement may have no impact or negative effects on the dynamism of the private sector if the allocation of contracts reflects political favouritism or corruption, targets the wrong type of firms or introduces other types of market distortions (Best et al., 2017).²

The analysis relates to two strands of the research literature on public procurement and economic development. The first focuses on criteria for – and participation in – public procurement by different types of firms, motivated by the fact that many procurement regimes seek to steer domestic tax revenues to expenditures on local firms (as opposed to foreign companies), and often target specific types of domestic firms (e.g., SMEs). Questions of interest to this literature centre on the extent to which policy affects the allocation of procurement. Does policy result in increased participation by targeted entities and if so what types of measures are most effective?³ To what extent does policy explain the very strong “home bias” that is observed empirically in the allocation of procurement contracts – reflected in government expenditures being much less import-intensive than those of the private sector?⁴ From an economic welfare (efficiency) perspective the main issue of interest in this line of research generally concerns the opportunity costs of domestic preference policies from a value-for-money perspective.⁵ In what follows we contribute to this strand of the literature by investigating the observed allocation of public procurement across firms in SSA countries, providing insight on the “revealed policy preference” implied by the pattern of procurement observed across different types of firms.

A second related strand of the literature focuses on the (potential) role of public procurement as an instrument of industrial policy. Here the interest is not on the allocation of public procurement across firms (i.e. whether procurement procedures attain value for money goals), but whether government contracts enhance the performance of firms and the domestic economy more generally. The

² There is a substantial literature on public procurement in developing countries that looks at it through the lens of corruption and governance. See e.g., Auriol et al. (2016), Dube et al. (2017), Peireira and Schwind (2017) and Knack et al. (2017) for two recent contributions.

³ Knack et al (2017) use a large sample of firms from developing countries and demonstrate that participation in public procurement by smaller firms is positively affected by measures to increase the transparency of the process and effective domestic appeals and review/audit mechanisms.

⁴ E.g., Branco (1994), Trionfetti (2000), Shingal (2015), Ragoussis (2016).

⁵ The presumption is that transparent, competitive processes that are open to all firms, including foreign companies, will minimize procurement costs. However, depending on market structures and the relative size of government demand for a product, discriminatory procurement may have no effect on prices (Evenett and Hoekman, 2005) and may even reduce them (McAfee and McMillan, 1989). In a recent paper analysing the case of Russia’s procurement price preferences for domestic firms, Best et al. (2017) find that on average there is no effect on prices of the (homogenous) goods procured, but that there is also substantial heterogeneity that is explained by the “quality” of the officials responsible for procuring goods.

presumption is that public procurement can complement supply-side policies aimed at enhancing competitiveness of firms by generating additional demand for domestic firms and thus supporting their growth and overall productivity performance.⁶ For example, Hebus and Zimmerman (2016) investigate the nexus between public procurement and capital investment for a sample of US firms and show that sales to the government relaxes financial constraints, permitting firms to increase capital investment. Ferraz et al. (2015) exploit a large dataset on procurement bids in Brazil and show that winning a government contract increases overall employment growth of the firms concerned. They argue that learning processes help the firms to compete on new markets and to develop new products, with the government contracts acting as the trigger for such “downstream” effects. Lee (2017) obtains similar results using Korean procurement data: firms that obtain short term public procurement contracts (which are exogenous because Korean procurement rules call for a share of contracts to be allocated randomly) experience increased growth and activity generally, over and above the effects of the activity associated with the public contract. This is observed in particular for small, young and financially-constrained firms.⁷

Our empirical analysis reveals that public procurement is a significant source of demand for many domestic firms in SSA. Government contracts account for a larger share of sales for domestic firms than foreign-owned ones, and are more important for larger and older firms. We find a strong positive relationship between government demand (selling to government entities) and the performance of firms in the low-income SSA countries covered by our dataset. Increasing the share of output sold to the government by 10 percentage points is associated with a 4 percentage point increase in productivity.⁸ There is substantial heterogeneity across firms, with the association between sales to the government and performance more evident for smaller and domestically-owned firms, as well as for firms that are at the bottom of the productivity distribution. Public procurement is positively related with other dimensions of firms’ performance as well, including the development of new products. The results are robust to different specifications, including accounting for potential selection bias and reverse causality.

The remainder of the paper is organized as follows. Section 2 introduces the data and some descriptive statistics on our sample of countries. Section 3 describes the empirical analysis. Section 4 presents the findings and the result of a number of robustness checks. Section 5 concludes.

2. Data

We exploit a large representative survey – the African Investor Survey (AIS) – administered by UNIDO and covering about 6,700 firms based in 19 SSA countries (UNIDO, 2011).⁹ The data were collected using a rigorous survey methodology, including stratified sampling (with three dimensions: sector, size and ownership of firms) and interview techniques (face-to-face interviews with top-level managers). The sample is representative of public and private for profit firms with 10 or more employees.

⁶ See Edler and Georghiou (2007) for a discussion of the role public procurement as a demand-side policy and Georghiou, Edler and Yeow (2014) for analysis of the design of procurement policy if governments desire to use procurement to promote innovation.

⁷ This econometric evidence complements the case study literature. See e.g., Ribeiro and Furtado (2014) for references to the literature and a case study of public procurement policy in Brazil to promote innovation (focusing on a Petrobras deep-water oil production platform contract).

⁸ As discussed further in what follows, we use different measures of firm-level productivity in the empirical analysis.

⁹ See <http://investment.unido.org/imp/About/AboutOurData.aspx>. The countries are: Burkina Faso, Burundi, Cameroon, Cape Verde, Ethiopia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia.

The richness of information provided by the AIS illustrates the heterogeneous dimensions of firms in the region. The sample includes both domestic (62.4% of the total) and foreign-owned firms (37.6% of the total). It covers mainly firms in the manufacturing and services sectors and provides detailed information on each company, including its 2-digit industry classification (based on the ISIC Rev. 3 classification), location, international trade position, and the financial variables necessary to compute standard indicators of firm performance. Most relevant for our purposes is that the survey includes a question asking firms to identify their main customers and the share of total sales going to six possible client groups: (1) retailers; (2) wholesale distributors; (3) manufacturers; (4) consumers; (5) government agencies; and (6) international organizations/NGOs. Among the 4,600 firms (68% of total sample) that responded to this specific question, 29.6% reported at least some sales to the Government. This information is roughly comparable with the World Bank Enterprise Surveys (WBES). For the sample of 19 SSA countries surveyed by UNIDO and for a similar time period the WBES data indicate that 23.2% of firms report securing (or attempting to do so) government contracts during the last year. Despite the differences in sample definitions and specific questions included in the UNIDO AIS and the WBES,¹⁰ the information concerning participation in procurement correlates quite well (see Figure A1 in the Appendix).

For the full sample of firms and countries, on average the government accounted for about 8.1% of firms' total sales (Figure 1). More disaggregated descriptive statistics reported in Table 1 reveal a heterogeneous picture: firm- and industry-specific characteristics affect the extent to which government matters as a source of demand. Domestic firms sell – on average – larger shares of their output to the Government compared to foreign-owned firms. Among foreign-owned firms, those from OECD economies report a higher share of total sales to the state. Although Southern multinationals have been successfully investing and contracting in the SSA region (Zhang and Gutman, 2015), it appears that such firms are less focused on the local government procurement market. The data also indicate that larger firms sell on average a greater share of their output to the government, as do firms that have been in operation for more than 10 years. Family-owned businesses in contrast appear less likely to take advantage of government demand.

The relative importance of government demand for firms varies across sectors. Not surprisingly, firms in the utilities and the construction sector report significantly higher shares of total output being sold to governments. Manufacturing firms sell proportionally less to government compared than firms in service sectors, this is especially true for traditional and lower tech type of activities. Producers of higher-tech products are likely to sell relatively less to Government.¹¹ Large differences in the relative importance of sales to the government are also observed across countries. Figure 2 shows that for some countries the share of Government demand in total sales of local firms is much greater than it is for other countries in the sample. This is the case for Burundi, Niger, Ethiopia and Rwanda. Some of these countries (such as Rwanda) reportedly have made substantial improvements in the management of their public procurement systems, as assessed by the Public Expenditure and Financial Accountability (PEFA) indicators.¹² Countries where firms on average report the lowest shares of output being sold to the government tend to have lower PEFA scores (see Appendix Table A1).

¹⁰ The UNIDO AIS includes a larger share of foreign firms in its sample than the WBES. In addition, the AIS question on public procurement differs from that in the WBES. The WBES asks firms to report whether they secured or attempted to secure public procurement over the last year, with the main goal of determining if kick-backs or bribes were paid when seeking such contracts. The AIS asks about actual levels of current sales to government entities. The AIS does not provide information on when tenders were submitted by firms or contracts were awarded.

¹¹ The mapping of manufacturing activities into technology categories uses a classification developed by OECD (2005). See UNIDO (2011, p. 62).

¹² See <https://pefa.org/>. World Bank (2016) provides more detailed indicators characterizing the legal and institutional design of national procurement systems but these do not include any information on the objectives of procurement

Table 1. Government demand across firm characteristics and sector

Firms' characteristics	Share of sales to Gov. (% on total sales)	Obs
Domestic	9.40%	2804
Foreign	6.04%	1785
Foreign firms from North	7.54%	764
Foreign firms from South	4.65%	711
Foreign firms from other SSA	6.12%	205
Family owned*	6.88%	3069
Government owned	18.29%	186
Small (<50)	7.61%	2058
Medium (50-100)	8.03%	924
Large (>100)	8.82%	1562
Young firm**	6.68%	1445
Old firm**	8.74%	3144
Exporter	4.59%	1325
non-Exporter	9.63%	2901
Capital city	8.78%	1830
Other cities	6.87%	2707
Agric. & Mining	4.52%	334
Manufacturing	6.32%	3124
Electricity-Water-Construction	28.86%	313
Services	8.38%	818
Low-tech Manuf.	5.90%	1735
Mid-tech Manuf.	6.00%	871
Hi-tech Manuf.	8.25%	518
Know-services	8.70%	523
Mkt-services	8.53%	490
Total number of firms		4600

Source: Authors' elaboration on AIS

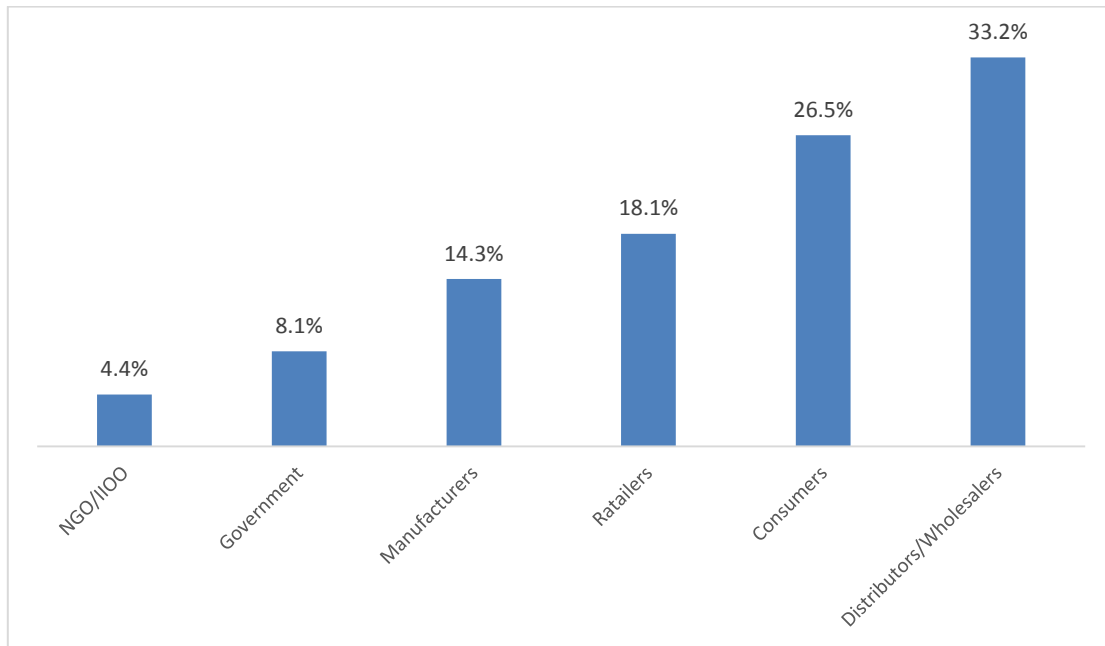
*Family holds more than 50.01%

**Younger/older than 10 years

(Contd.) _____

regimes, the extent to which there are preferences for certain types of bidders or the prevalence of kick-backs and other corrupt practices.

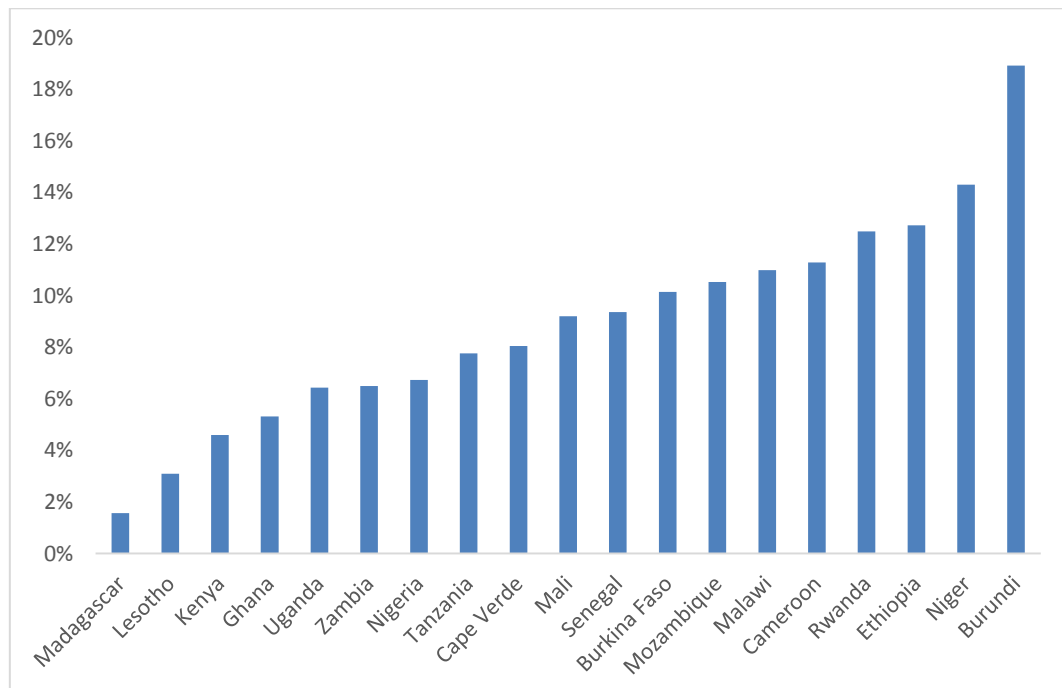
Figure 1. Average share of sales by main buyers



Note: IIOO: International organization.

Source: Authors' calculations based on UNIDO AIS data.

Figure 2. Average share of sales to Gov. (as a % of total sales), by country



Source: Authors' calculations based on UNIDO AIS data.

3. Empirical Analysis

Following the voluminous literature on heterogeneous firms (e.g., Helpman et al., 2004), our empirical model is based on the following general functional relationship linking firm performance to a vector of firm-specific factors and a measure of government demand:¹³

$$y_{ijx} = \sum \beta Z_i + \gamma share_gov_i + \theta_j + \delta_x + \varepsilon_{ijx} \quad (1)$$

In this model, y is a performance indicator for firm i in country j and sector x . In our main estimates we use an indicator of labour productivity (*lab_prod*), constructed as the sales per employee, but we also use alternative performance indicators, including value added per worker, capital intensity, wages, and innovation. The variable Z is a vector of standard controls used in the literature to account for firm heterogeneity. More specifically, we add the age (*age*) and the size (*size_class*) of the firm, both expected to be positively correlated with productivity (Helpman et al., 2004), and whether a firm is family owned (*family*), which usually has a negative impact on firm performance. We account also for export status (*exporter*) and foreign ownership (*foreign*), both of which are generally significant predictors of superior performance, including in the African context (Foster-McGregor et al. 2014), and control for the skill intensity of workers in a firm (*skill_ratio*). In addition, we include a full set of country and industry fixed effects to account for all unobserved contextual factors that may influence the relationship between Government demand and firm performance. These include both cross-country differences in levels of development, institutions and regulation of the procurement process, as well as for the fact that some industries (such as construction, as shown in Table 1) may rely more on procurement markets and have different levels of technology intensity.

The coefficient of interest, γ , accounts for the share of firm i total sales to government entities. For our sample countries we expect this variable to be positively related with indicators of firm performance. Effective public procurement regimes that emphasize value for money mimic the market by generating competition between suppliers, the aim being that the most efficient firms win contracts. Insofar as this is the case, there should be no difference between firms that sell (more) to the government and those that sell to other customers (private buyers). However, this need not be so if public procurement is used as an instrument of industrial policy or if it is distorted by corruption or collusion between bidders. In low-income SSA economies, firms generally have low levels of productivity and are often growth constrained, reflecting poor business environments, limited access to credit and structural characteristics such as small size and limited international exposure (Clarke 2012; Iacovone et al. 2014). Public procurement may help offset such supply side constraints by increasing demand for firms' output.

Demand from the government can positively affect firm performance through different channels. First, to the extent that government demand is additional (acts as an exogenous increase in demand for the firm's output), it may allow firms to relax some of the constraints they confront (e.g. access to finance), mobilizing resources to invest and enhance their performance (as in Habous and Zimmerman, 2016 and Lee, 2017). Second, as suggested by Ferraz et al. (2015), firms winning procurement bids may benefit from learning mechanisms, insofar as winning a procurement contract allows them to better understand the dynamics of demand for their products, potentially feeding into growth along the extensive margin (penetrate new markets; obtain new clients). Third, government demand may incentivize pursuit of more risky activities, such as development and introduction of new (differentiated) products and new investments in R&D (Edler and Georghiou, 2007; Aschhoff et al.,

¹³ A full description of the variables introduced in equation (1), together with descriptive statistics, is provided in Appendix Table A2.

2009; Slatchev and Wiederhold, 2016). Of course, these mechanisms may not apply equally to all types of firms and sectors – the relationship will be heterogeneous, depending on firm characteristics.

While the literature suggests that government demand may be important for firms that are smaller and younger and/or have limited access to finance and high innovative potential (Acemoglu et al., 2013; Ferraz et al, 2015; Habous and Zimmerman, 2016), the effect of public procurement (government demand) need not to be positive. In practice, the design of procurement policy and its implementation will matter. If procurement reflects a process of generating and sharing rents between “connected” firms and government officials, positive performance effects either may not be observed or be smaller than they would otherwise be.

A preliminary look at our data suggests there is a positive procurement/performance nexus in low-income SSA countries. Figure 3 reports the kernel distribution of the estimated coefficient for labour productivity, distinguishing between firms that sell to the government (independently of the share of total output being sold) and firms that do not. The graph shows that the distribution of the former group tends to dominate the latter, reflected in a rightward shift. In addition, Figure 4 reports the relationship between productivity and the size of government demand, suggesting a weak positive association.

Figure 3. Kernel distribution of productivity

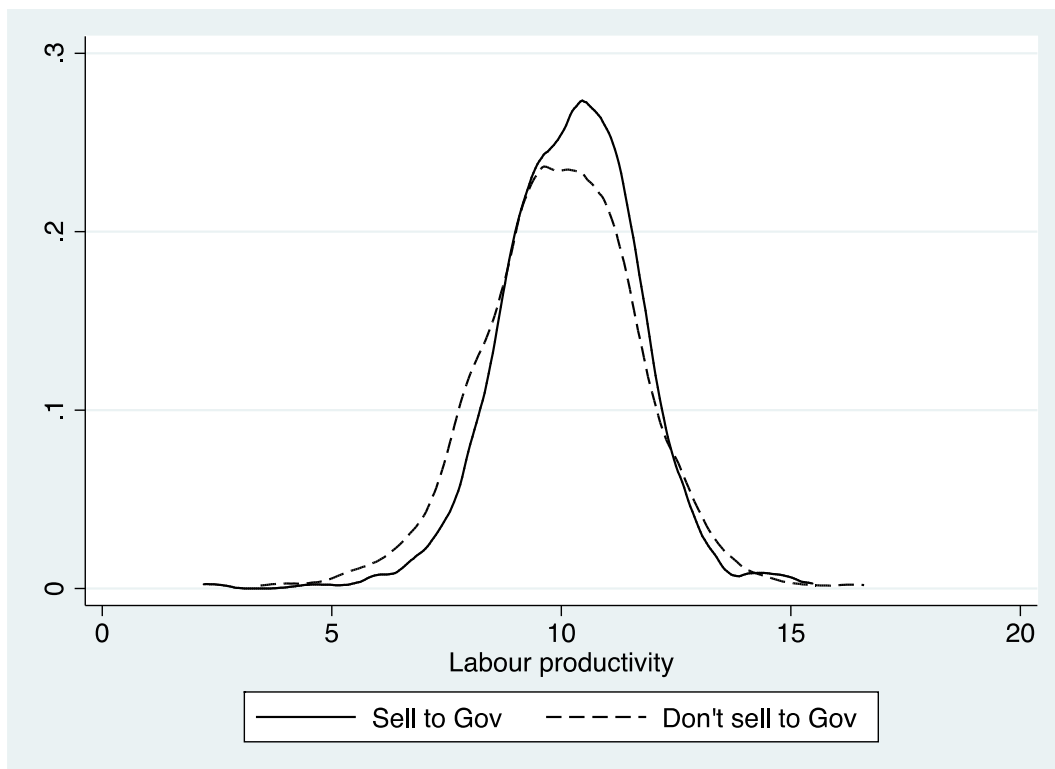
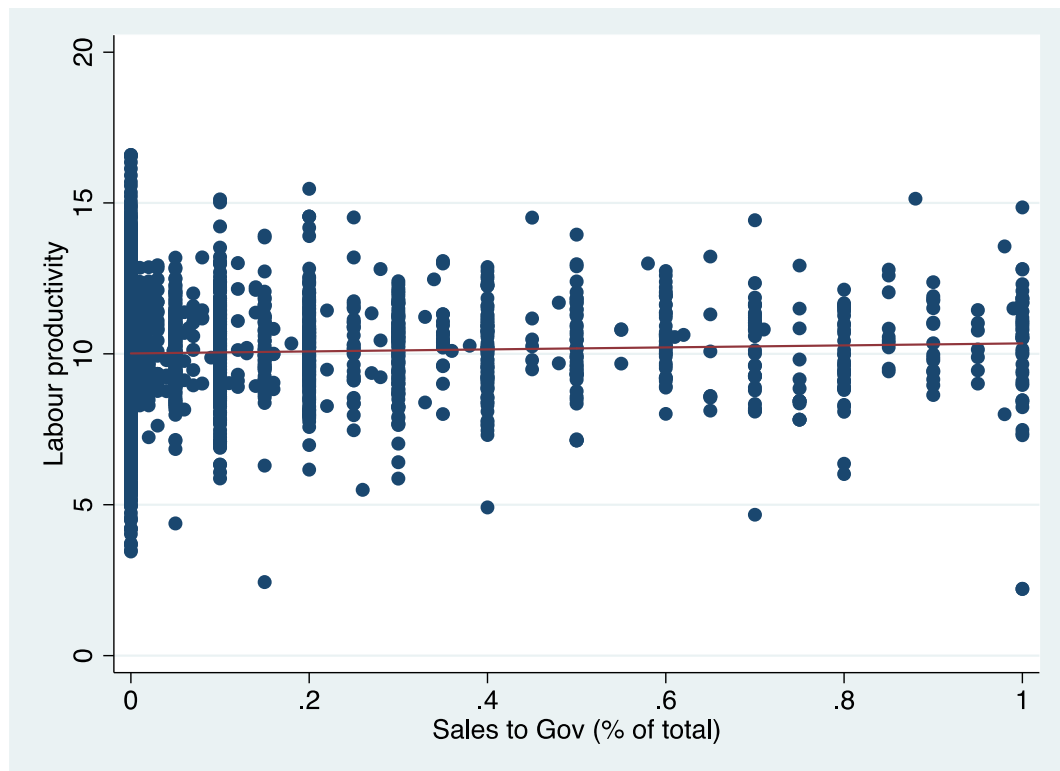


Figure 4. Productivity and sales to Government



4. Results

Table 2 reports the results of estimating equation (1) using OLS. The model generally performs well, and all the major controls included have the expected sign. As indicated in Column 1, we replicate the well-known existing empirical evidence on performance of heterogeneous firms: larger and older firms are significantly more productive, as are those employing a greater number of skilled workers. Higher levels of productivity are observed also among firms that export and those that are foreign owned. On the other hand, we find that family-owned firms are less productive compared to others.

Moving to our variable of interest (Table 2, column 1), we find that the share of sales to government is positively associated with firm performance. The estimate is statistically significant at the 1 percent level, demonstrating a strong correlation between government demand and firm performance. The size of the coefficient is not only statistically, but also economically significant. Increasing the share of output sold to the government by 10 percentage points is associated with an increase in the level of productivity of about 4 percentage points.

While selling to the government may help firms improve productivity performance, dependence on the state also may represent an obstacle to firm growth if firms lack alternative markets. For this reason, in column (2) we test the hypothesis that the relationship between government demand and firm performance may be non-linear. We find indeed that the squared coefficient of labour productivity turns negative (and is statistically significant) as the share of total output sold to the state rises, with a turning point reached when two-thirds of total sales are to the government. To complete this first set of results, in column (3) we replace our variable of interest with a dummy taking the value of 1 if firms sell to the government and 0 otherwise. The coefficient estimate is again positive and significant, indicating there is on average a 20 percent difference in productivity levels between the two groups of firms. Finally, in column (4) we explore whether government demand is a specific

mechanism that enhances firm performance as opposed to demand by non-commercial entities more generally. We replace our coefficient of interest with the share of output sold by each firm to international organizations and non-profit organizations (NGOs). These types of buyers are more likely to have as overriding objective maximizing value for money. The coefficient for this variable is positive but not statistically significant, providing suggestive evidence that government procurement may be acting as an industrial policy tool.

Table 2. Main results

VARIABLES	(1) Main	(2) Squared_term	(3) Main_dummy	(4) int. procurement
size_class	0.241*** (0.0289)	0.242*** (0.0289)	0.240*** (0.0289)	0.246*** (0.0290)
age	0.175*** (0.0304)	0.172*** (0.0304)	0.171*** (0.0304)	0.182*** (0.0301)
exporter	0.328*** (0.0558)	0.326*** (0.0558)	0.324*** (0.0558)	0.318*** (0.0560)
foreign	0.455*** (0.0529)	0.456*** (0.0528)	0.457*** (0.0528)	0.447*** (0.0527)
family	-0.265*** (0.0559)	-0.264*** (0.0559)	-0.265*** (0.0557)	-0.270*** (0.0559)
skill_ratio	1.152*** (0.145)	1.145*** (0.145)	1.146*** (0.145)	1.179*** (0.145)
share_gov	0.400*** (0.129)	0.930*** (0.309)		
Proc_dumy			0.202*** (0.0488)	
share_gov^2		-0.708* (0.388)		
Share_iioo				0.210 (0.172)
Observations	4,103	4,103	4,103	4,101
R-squared	0.325	0.325	0.326	0.323
Country Effects	Y	Y	Y	Y
Industry Effects	Y	Y	Y	Y

Robust standard errors in parentheses

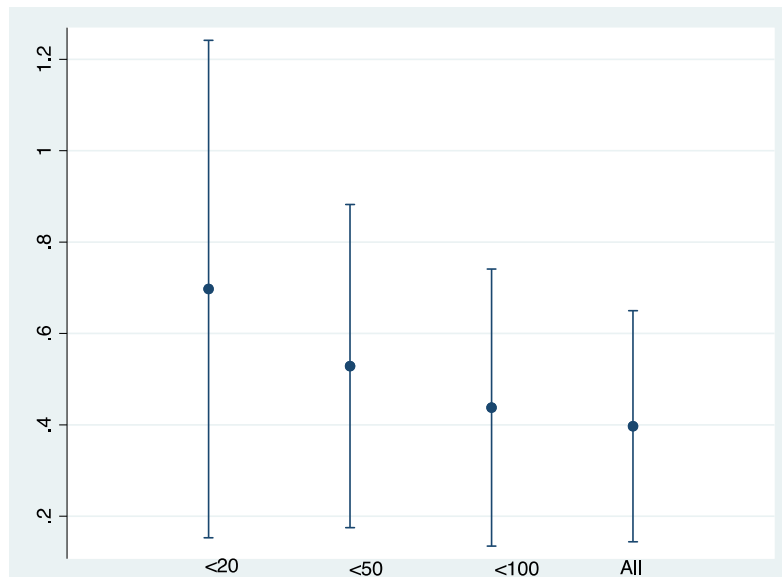
*** p<0.01, ** p<0.05, * p<0.1

4.1 Results: firm heterogeneity and other mechanisms

We next investigate whether the positive relationship between procurement (sales to the government) and productivity varies across different sub-samples of firms and is affected by specific characteristics, location or sector of activity. In columns (1)-(2) of Table 3 we split the sample between domestic and foreign-owned firms. The coefficient estimate on the share of output sold to the government is statistically significant only for the former group. In columns (3)-(4) we differentiate between SMEs (firms with fewer than 100 employees) and large companies, the positive correlation appears only for the group spanning the smaller firms. If we further disaggregate the group of SMEs into firms with

less than 50 employees and “micro” enterprises¹⁴ with fewer than 20 employees, the size of the coefficient increases for smaller firms, confirming that public procurement has proportionally higher potential on smaller, demand constrained, firms (see Figure 5). The lack of statistical significance of the estimates for larger and foreign-owned firms could be due to these firms having higher levels of productivity, which might not be impacted by selling to the government. However, taken together, these results suggest that additional demand stemming from government contracts may positively affect the performance of the set of firms that are most likely to be growth constrained, i.e. domestically-owned firms and SMEs.

Figure 5. Coefficient share_{gov} by size of firms



Notes: The figure plots coefficients and their confidence intervals based on separate regressions run on samples including (1) micro firms (with less than 20 employees); (2) small firms (less than 50); (3) SMEs (less than 100); (4) the whole sample.

Results in columns (5)-(6) of Table 3 show that the positive association between government demand and performance is mostly concentrated among firms in the manufacturing sector (excluding construction). There is no statistically significant effect for firms in services sectors. Finally, if we split the sample into firms located in the capital city and those based elsewhere (Columns 7-8), we find evidence that location matters. In the remaining columns of Table 3 we interact our variable of interest with country specific variables. First, we control for the level of corruption prevailing in each country. The procurement literature notes that weak public sector governance can discourage competitive firms from participating in procurement processes, reflecting expectations that bids will not be awarded on the basis of published requirements (Evenett and Hoekman, 2005; Best et al., 2017; Knack et al., 2017). One potential consequence is to reduce any effect of government demand on productivity as winning contracts will be determined in part by the ability and willingness to provide side-payments.

¹⁴ We are unable to identify micro enterprises on the basis of the usual threshold used in the literature (<10 employees) because the AIS data cover a representative sample of registered firms that employ more than ten workers (UNIDO, 2011: 183).

Table 3: Firm Heterogeneity and Additional Controls

VARIABLES	(1) Domestic	(2) Foreign	(3) SMEs	(4) Large	(5) Manuf.	(6) Services	(7) Capital_city	(8) Othr city	(9) Corruption	(10) Tariffs	(11) Targeting
size_class	0.330*** (0.0360)	0.0933* (0.0496)	0.145** (0.0633)		0.256*** (0.0333)	0.175** (0.0766)	0.201*** (0.0368)	0.253*** (0.0532)	0.241*** (0.0289)	0.249*** (0.0347)	0.306*** (0.0408)
age	0.104*** (0.0371)	0.250*** (0.0546)	0.113*** (0.0378)	0.222*** (0.0533)	0.161*** (0.0357)	0.212*** (0.0767)	0.204*** (0.0392)	0.160*** (0.0568)	0.175*** (0.0304)	0.153*** (0.0369)	0.159*** (0.0417)
exporter	0.327*** (0.0747)	0.378*** (0.0863)	0.404*** (0.0747)	0.257*** (0.0867)	0.354*** (0.0616)	0.423** (0.167)	0.307*** (0.0693)	0.354*** (0.104)	0.328*** (0.0558)	0.292*** (0.0642)	0.214*** (0.0731)
foreign			0.553*** (0.0677)	0.360*** (0.0890)	0.506*** (0.0625)	0.679*** (0.136)	0.531*** (0.0647)	0.387*** (0.107)	0.455*** (0.0528)	0.469*** (0.0653)	0.487*** (0.0744)
family	-0.228*** (0.0575)		-0.308*** (0.0652)	0.0977 (0.112)	-0.199*** (0.0638)	-0.162 (0.139)	-0.177** (0.0735)	-0.327*** (0.0953)	-0.265*** (0.0559)	-0.284*** (0.0674)	-0.218*** (0.0803)
skill_ratio	0.766*** (0.172)	1.768*** (0.253)	0.856*** (0.182)	1.599*** (0.245)	1.283*** (0.196)	0.497* (0.282)	0.960*** (0.178)	1.244*** (0.288)	1.152*** (0.145)	1.352*** (0.201)	1.405*** (0.251)
share_gov	0.375** (0.148)	0.446 (0.287)	0.437*** (0.154)	0.329 (0.230)	0.480*** (0.164)	0.300 (0.311)	0.439*** (0.155)	0.489* (0.265)	0.403* (0.213)	0.158 (0.209)	0.203 (0.199)
share_gov*corruption									0.00511 (0.269)		
share_gov*tariff										0.0103** (0.00463)	
share_gov*targeting											1.270*** (0.416)
Observations	2,485	1,612	2,676	1,424	2,817	720	2,415	1,402	4,103	2,787	1,799
R-squared	0.328	0.282	0.335	0.315	0.342	0.294	0.341	0.321	0.325	0.314	0.373
Country fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We find that the interaction term is not statistically significant, suggesting that higher levels of overall corruption do not affect the mechanisms through which procurement relates to performance.¹⁵ Second, we interact the government demand variable with average import tariffs for the products being procured and an indicator measuring whether sectors have been targeted by national investment promotion activities (both indicators exclude services).¹⁶ These variables can be regarded as rough indicators of industrial policy. The results indicate that the performance-procurement relationship is bolstered in the presence of complementary sectoral policies.

4.2 Additional results

In this sub-section, we implement additional empirical tests to assess the robustness of our results to (a) different definitions of the dependent variable; and (b) alternative empirical strategies. Table 4 reports the results of our main specification using alternative indicators of firm-level performance, including value added per worker¹⁷ (leading to a reduction in the number of observations) and a measure of total factor productivity (TFP).¹⁸ Columns (1)-(2) reveal that results do not change much; the signs and magnitudes of the estimates are very similar to our main results.

The same result obtains for alternative indicators of performance, including the capital labour ratio, the level of wages per worker and two measures of innovation, the introduction of new products and implementing process innovations. Firms that sell a greater share of their output to the government are more likely to introduce new products as opposed to engage in process innovation. This result is consistent with findings in the extant literature showing a nexus between public procurement and the development of innovative capacities by firms in OECD economies (Ashhoff and Sofka, 2009; Slavtchev and Wiederhold, 2016; Czarnitzki et al., 2016). To the best of our knowledge there is no evidence regarding government demand as a driver of innovation processes in low-income economies in general, and in SSA countries in particular. As noted previously, the literature highlights several channels through which government demand can incentivize innovation and help to offset supply-side constraints, including by creating new markets for products, providing a testing ground for innovative products and learning by doing (Kattel and Lember, 2010). While data limitations prevent us from investigating the salience of such mechanisms in SSA, it is noteworthy that we observe this relationship in our sample countries.

¹⁵ The lack of statistical significance obtains as well if alternative indicators of institutional quality are used, such as the rule of law or the political stability index.

¹⁶ Sector targeting is a dummy variable taking the value of 1 if the industry has been targeted prior to 2003 for specific promotion towards foreign investors (Harding and Javorcik, 2012). For the purposes of this paper, it can either be intended as a measure related to industrial policy, aimed at increasing the competitiveness of the industry, or as a measure of competition, due to the likely large presence of foreign investors.

¹⁷ Value added is measured by subtracting the value of purchased inputs and the costs of advertising to the output to total sales.

¹⁸ TFP is constructed by dividing sales on the weighted sum of inputs, assuming a 2/3 share for labour and 1/3 for capital (fixed assets).

Table 4. Results using alternative indicators of firm performance

VARIABLES	(1) VA_EMP	(2) TFP	(3) K/L	(4) WAGES	(5) PRODUCT_INNO	(6) PROCESS_INNO
size_class	0.206*** (0.0343)	0.184*** (0.0275)	0.160*** (0.0374)	0.113*** (0.0243)	0.0789* (0.0430)	0.139*** (0.0418)
age	0.153*** (0.0349)	0.140*** (0.0283)	0.135*** (0.0398)	0.135*** (0.0248)	0.0382 (0.0450)	0.0282 (0.0441)
exporter	0.218*** (0.0672)	0.250*** (0.0537)	0.315*** (0.0685)	0.118** (0.0465)	0.406*** (0.0807)	
foreign	0.480*** (0.0620)	0.356*** (0.0504)	0.229*** (0.0638)	0.355*** (0.0437)		
family	-0.321*** (0.0663)	-0.172*** (0.0517)	-0.383*** (0.0753)	-0.174*** (0.0479)	0.0260 (0.0674)	-0.0510 (0.0682)
skill_ratio	1.003*** (0.173)	0.991*** (0.146)	0.419* (0.215)	0.872*** (0.128)	0.00976 (0.231)	-0.0714 (0.228)
share_gov	0.391*** (0.145)	0.315** (0.125)	0.337** (0.149)	0.252*** (0.0926)	0.344** (0.173)	0.0798 (0.176)
Constant					-2.326*** (0.420)	-1.398*** (0.338)
Observations	3,606	4,021	4,051	3,910	1,954	2,111
R-squared	0.347	0.275	0.197	0.265		
Country	Y	Y	Y	Y	Y	Y
Effects						
Industry	Y	Y	Y	Y	Y	Y
Effects						

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

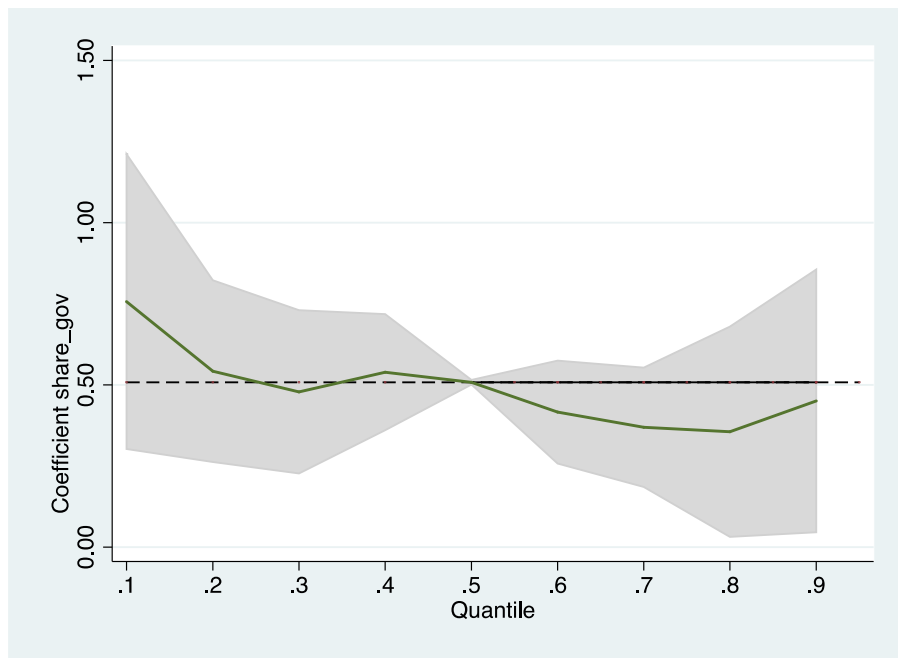
Note: Results of columns (5)-(6) are based on a standard Probit estimator. Information on (product and process innovation) is only available for the sub-sample of domestic firms.

Finally, we estimate our main model using a quantile regression approach to better account for heterogeneity in the distribution of firm performance by measuring the relationship with government demand at different points of the conditional productivity distribution (i.e. distinguishing more precisely whether the correlation is stronger/weaker than the average for less/more productive firms). In addition to extending our main results, a quantile regression approach also improves on OLS due to its capacity to accommodate outliers and greater robustness to heteroscedasticity. Following Foster-McGregor et al (2014), who adopt a similar approach (and use the same AIS data as we do), we employ a method developed by Canay (2011) that accounts for the potential incidental parameters problem from the inclusion of a large number of fixed effects (in our case at the country and industry level). The approach consists of first estimating the fixed effects ($\hat{\theta}_j; \hat{\delta}_x$) from the standard conditional model using OLS and then, assuming they are constant across quantiles, defining a new dependent variable given by:

$$\hat{y}_i = y_i - \hat{\theta}_j - \hat{\delta}_x$$

We then use this dependent variable to estimate a simultaneous quantile regression model with bootstrapped standard errors. Results of the quantile regression for our variable of interest are summarized in Figure 6; the full set of results is reported in Appendix Table A3. The overall size of the coefficient of interest is close to the one estimated with OLS, but Figure 6 shows a slightly decreasing trend in the size of the coefficient along the quantiles of the productivity distribution. This reveals that the incidence of government demand is stronger for firms with lower levels of productivity, which appears consistent with our results regarding the significant correlations between public procurement participation and performance of domestic firms and SMEs. Both are more likely to be at the bottom of the productivity ladder in SSA.

Figure 6. Coefficient share_gov across quantiles



Note: The figure plots coefficients of the quantile regression outputs reported in Appendix Table A3.

4.3 Robustness Checks and Endogeneity

The cross-section nature of our data precludes any claims or inference of a causal relationship between the intensity of public procurement participation and firm performance. Our results may be affected by endogeneity as a result of possible self-selection of better performing firms into government procurement, or government entities selecting more productive firms when undertaking procurement. Recent papers that have estimated the effects of procurement on different dimensions of firm performance are able to address such potential endogeneity issues by having panel data that permit conditioning on the characteristics of the firms before winning procurement bids, and exploiting a quasi-experimental setting as a result of specific features of the procurement process analysed (Ferraz et al., 2015; Hebous and Zimmerman, 2016; Lee, 2017).

The cross-sectional nature of our data impede the use of standard approaches to address endogeneity in a robust manner. Instead, we try to address the selection issue by constructing a control group of firms that display as much as possible the same characteristics as firms receiving the treatment (selling to the government). A basic limitation here is that we do not have information on the exact time firms began to sell to the government. Nonetheless, this approach is frequently used in cross-sectional studies to disentangle potential bias arising from the heterogeneity of the firms in our sample.¹⁹ We implement a matching methodology by selecting among the 3,268 firms that do not sell to the Government a control group based on characteristics that help predicting selection into procurement. The latter are found by running a probit model in which the probability of finding firms with positive shares of sales to the government depends on the same factors that we include in our OLS model (size, ownership, skills) plus the inclusion of the level of productivity observed in the two years preceding the survey. Pairs of country-industry fixed effects are added to constrain control group firms to be in the same country/industry as the treated firms (those that sell to the government).

Results of the selection model are reported in Appendix Table A4. On the basis of the selection model we then construct inverse probability weights (IPW) that we use in our main regressions to provide a better comparison between controls and treated firms. To assess the results of the matching procedure just described, Figure A2 plots the distribution of the IPW of the two groups before and after weighting, showing that these are almost overlapping in the latter case. Results of the weighted regression are reported in the first column of Table A4. Coefficient estimates remain very similar. That for the share of procurement has a magnitude only slightly smaller than the baseline (0.36 instead of 0.4).²⁰

Second, we try to address potential endogeneity concerns by adopting an instrumental variable (IV) approach that exploits the cross-country variation in the data. We construct an instrument from the IMF Government Finance Statistics, using the average ratio of total Government spending to GDP for each country in our sample over the last decade (see Appendix Figure A3). Higher ratios of government spending to GDP should be positively associated with greater spending on goods and services (public procurement), and therefore the probability of firms securing procurement contracts, as well as the magnitude of their sales to government entities. While overall spending is not necessarily correlated with individual firm performance – it is much broader in scope – since this indicator is country variant, it will be absorbed by country fixed effects in the first stage. For each

¹⁹ For example, in an empirical setting that is very similar to ours, Czarnitzki et al. (2016) apply matching methods to construct a control sample of firms not receiving procurement to evaluate the effects of procurement on innovation for a cross section of German firms.

²⁰ As an additional test, we have also used a standard matching estimator based on the Leuven and Sianesi (2003) algorithm, comparing directly how differences in firms' productivity are affected by the simple treatment (a dummy indicating if firms sell to the Government, without accounting for the shares). Results remain consistently similar to those reported in column (2) of Table 2, with an average treatment effect on the treated firms of about 0.2 when using the nearest neighbour estimator with common support.

country-industry pair we compute a variable measuring the share of firms selling to the Government on the total, as a proxy for the probability of each firm to be exposed to procurement.²¹ Our instrument is given by the combination of these two variables.

Results, reported in the second column of Table A4, show that the instrument is relevant in the first stage, and that in the second stage the positive relationship between government demand and firm productivity is confirmed, with a coefficient that is similar in magnitude to our baseline model. We also test our IV strategy using two variables measuring access to procurement: (i) the PEFA indicator that assesses the performance (quality) of the national public procurement system; and (ii) the share of procurement-related bribes and payments reported by firms in the WBES (Knack et al. 2017). In both cases the IV estimation generates results that are consistent with our baseline findings.

5. Conclusion

Most public procurement systems aim to achieve “value for money” and much the research and policy literature on procurement focuses on this dimension of procurement. Less attention has been given to the prevalence and effectiveness of public procurement as a tool to support (enhance) the performance of domestic firms. In practice procurement tends to be characterized by a strong ‘home bias’ – most contracts are awarded to national, and often local, companies. This is as true in high-income countries as it is in lower-income countries. Indeed, for the latter the share of total procurement that is allocated to foreign firms (including imports) is often higher than in high-income nations as a result of limited industrial capacity and aid dependence (Evenett and Hoekman, 2013). There are many reasons why procuring entities may prefer to spend tax revenues at home, including efficiency rationales: it may minimize costs and ensure greater control and accountability for performance (Breton and Salmon, 1995).

In this paper we do not aim to assess to what extent procurement policies are designed to favour local sourcing and what the effects of extant policies are.²² Instead our goal is much less ambitious: we exploit a new source of firm-level data for SSA countries that provides information on the extent to which different types of firms sell their output to government entities. This provides new insights into how overall procurement activity across SSA countries is allocated, and whether participation in public procurement is associated with realization of the types of goals that underlie industrial policy – an improvement in measures of firm performance.

We find that the allocation of public procurement is associated with higher levels of productivity of the firms that sell more of their output to government entities. This is most strongly the case – both in terms of statistical significance and economic magnitude of the relationship – for domestically-owned firms, especially SMEs, companies engaged in manufacturing activities and those located in the capital city. A positive relationship between procurement and performance is not observed for foreign-owned firms or companies that are in the service sector. The results are suggestive that – whatever the underlying policy objectives that may guide the allocation of government contracts – public

²¹ Since we cannot exploit pre-sample information on the distribution of firms selling to the government across sectors and countries, this variable is contemporaneous to our variable of interest. This clearly raises the risk of lack of validity of our instrument, violating the exclusion restriction. Especially when the number of observations at the country-industry pair is small, this reduces granularity of information and it is likely to identify a few firms and likely to correlate with the dependent variable as well. In additional analyses we have also constructed this measure at the industry level, i.e. by pooling countries. Results remain unaffected.

²² In part this is because we lack good information on the intent of procurement regimes and have no information on the overall allocation of the value of government procurement for the SSA countries in the sample. Extant efforts to characterize procurement systems – such as World Bank (2016) – do not document the policy objectives underlying procurement regulations.

procurement activity in the SSA countries in our sample is associated with outcomes that generally motivate industrial development policies.

Our findings raise many questions and suggest a number of areas for further research. One question concerns the role of foreign-owned companies in procurement. The fact that we do not observe a relationship between sales to the government and indicators of firm performance is not surprising given the presumption that foreign-owned firms tend to have higher productivity. The interesting question here concerns how much foreign firms engage in bidding for procurement contracts. FDI is often mentioned as an avenue through which foreign firms can contest procurement markets insofar as having local presence is a necessary condition to sell to governments. This need not have anything to do with policy – in the case of services in particular the nature of the activities may simply require a local presence (Evenett and Hoekman, 2005). Better understanding the nexus between foreign investment and the allocation of procurement contracts for goods and services across firms in SSA.

Another interesting question concerns our finding that the effects of procurement may depend on complementary policies that go beyond directly targeting supply-side constraints. The large positive and significant coefficient estimate for the interaction between the share of total sales to the government and the prevalence of inward investment promotion activities in the relevant sectors suggests such complementarities may be important. This is a subject where further research may be fruitful from a policy perspective. Kutlina-Dimitrova and Lakatos (2016), for example, use very detailed panel data on EU procurement and among other things find that trade and FDI policies as well as the quality of ‘behind-the-border’ product market regulation has an impact on the allocation of procurement.

Unfortunately, these and other questions all require additional data on overall procurement activity at the national level and its allocation by sector and type of firm. Such data are not available for SSA countries. The suggestive results obtained here will hopefully help to stimulate efforts by governments to generate such data. What is needed first and foremost is to extend the time dimension of firm-level data on participation in public procurement.

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APPENDIX

Table A1. Public expenditure & financial accountability score (available SSA sample countries)

Country	Period	Overall	(i) Transparency, comprehensiveness and competition in legal & regulatory framework	(ii) Use of competitive procurement methods	(iii) Public access to complete, reliable and timely procurement information	(iv) Existence of an independent procurement complaints system
Burkina Faso	Apr. 07	C+	D	C	A	NU
Burkina Faso	Jun. 10	B	C	B	A	NU
Burkina Faso	Jun. 14	B+	B	A	B	B
Burundi	Feb. 09	D+	D	C	C	NU
Burundi	Mar. 12	C+	B	D	D	A
Cape Verde	Dec. 08	B	B	B	C	NU
Cape Verde	May 16	C+	B	D	D	A
Ethiopia	Oct. 07	C+	D	B	B	NU
Ethiopia	Sep. 10	C+	D	B	B	NU
Ethiopia	Apr.15	C+	B	D	C	B
Ghana	Jun. 06	NR	C	NR	NR	NU
Ghana	Jan. 10	B+	A	B	B	NU
Ghana	Jun. 13	C	B	D	D	B
Kenya	Jul. 06	B	C	B	A	NU
Kenya	Mar. 09	B	C	B	A	NU
Kenya	Aug. 12	C+	B	D	B	B
Lesotho	Jun. 07	NU	NU	NU	NU	NU
Lesotho	Nov. 12	D+	B	D	D	D
Madagascar	May 06	C	C	C	C	NU
Madagascar	May 08	C	D	B	C	C
Madagascar	Aug. 14	D+	B	D	D	D
Malawi	Jun. 08	NR	NR	C	C	NU
Malawi	Mar. 11	C	B	D	D	B
Mali	Dec. 08	C	B	D	C	NU
Mali	Jun. 11	C	B	D	C	NU
Mali	Oct.16	B+	B	B	B	A
Mozambique	Mar. 06	C	C	C	C	NU
Mozambique	Feb. 08	B	B	C	B	NU
Mozambique	Mar. 11	B	B	C	B	NU
Mozambique	Dec.15	D+	B	D	D	D
Niger	Dec. 08	B	B	B	B	NU
Niger	Mar. 13	B+	A	B	B	A
Rwanda	Jun. 08	B	A	C	B	NU
Rwanda	Nov. 10	A	A	A	A	NU
Senegal	Jun. 11	B+	B	A	B	A
Tanzania	Jun. 06	C+	NU	NU	NU	NU
Tanzania	Nov. 10	B	B	B	B	NU
Tanzania	Sep. 13	NR	B	NR	NR	D
Uganda	Mar. 08	C	D	C	B	NU
Uganda	Jun. 09	D+	NR	D	C	NU
Uganda	Sep. 12	D+	B	D	C	D
Zambia	Dec. 05	D+	D	C	C	NU
Zambia	Jun. 13	D+	B	D	D	D

Source: <https://pefa.org/>.

Table A2. Descriptive Statistics

Variable name	Description	Obs.	Mean	Std. Dev.	Min	Max
lab_prod	Sales on employees (log)	6398	10.04	1.67	1.54	16.59
va_emp	Value added on employees (log)	5666	9.47	1.82	-0.11	16.58
tfp	Total Factor Productivity (log)	6207	7.00	1.49	-0.64	15.76
kl	Capital labour ratio (log)	6369	9.11	1.99	0	18.21
wage	Wage per capita (log)	6097	7.91	1.32	-4.66	15.88
product_inno	Dummy, 1 if product innovation	2280	0.32	0.47	0	1
process_inno	Dummy, 1 if process innovation	2272	0.22	0.41	0	1
size_class	1 if small, 2 if medium, 3 if large	6618	1.85	0.89	1	3
lage	Age of the firm (log)	6641	2.62	0.81	0	5.09
exporter	Dummy, 1 if exporting	5978	0.25	0.44	0	1
foreign	Dummy, 1 if foreign owned	6719	0.38	0.48	0	1
family	Dummy, 1 if family owned	6719	0.25	0.43	0	1
skill_ratio	Ratio of skilled on unskilled	6437	0.23	0.21	0	1
share_gov	Share of Sales to Government (% of total)	4589	0.08	0.19	0	1
control corr	Control of Corruption	6719	-0.54	0.50	-1.11	0.80
tariffs	Weighted tariffs	3306	25.32	29.56	0	200
sector_targeting	Sector Targeting	1994	0.24	0.43	0	1

Table A3. Quantile regression results

VARIABLES	(1) q10	(2) q20	(3) q30	(4) q40	(5) q50	(6) q60	(7) q70	(8) q80	(9) q90
size_class	0.216*** (0.0520)	0.244*** (0.0312)	0.281*** (0.0278)	0.263*** (0.0320)	0.265*** (0.0215)	0.266*** (0.0260)	0.240*** (0.0240)	0.228*** (0.0326)	0.261*** (0.0426)
age	0.296*** (0.0517)	0.250*** (0.0355)	0.251*** (0.0311)	0.219*** (0.0300)	0.180*** (0.0320)	0.142*** (0.0334)	0.122*** (0.0352)	0.0897*** (0.0314)	0.00127 (0.0552)
exporter	0.296** (0.121)	0.234*** (0.0832)	0.179** (0.0812)	0.218*** (0.0695)	0.265*** (0.0639)	0.316*** (0.0594)	0.405*** (0.0730)	0.450*** (0.0813)	0.480*** (0.0776)
foreign	0.298*** (0.103)	0.448*** (0.0728)	0.451*** (0.0729)	0.434*** (0.0715)	0.465*** (0.0627)	0.391*** (0.0631)	0.452*** (0.0802)	0.469*** (0.0860)	0.555*** (0.0944)
family	-0.403*** (0.0922)	-0.276*** (0.0762)	-0.238*** (0.0689)	-0.208*** (0.0666)	-0.212*** (0.0604)	-0.278*** (0.0551)	-0.252*** (0.0663)	-0.242*** (0.0576)	-0.196** (0.0902)
skill_ratio	1.089*** (0.308)	1.071*** (0.171)	1.096*** (0.152)	1.007*** (0.162)	0.959*** (0.158)	0.995*** (0.150)	1.136*** (0.179)	0.980*** (0.180)	1.126*** (0.353)
share_gov	0.536** (0.262)	0.446*** (0.129)	0.236** (0.114)	0.254* (0.145)	0.373*** (0.122)	0.262** (0.117)	0.317*** (0.107)	0.375*** (0.128)	0.406*** (0.147)
Constant	6.957*** (0.180)	7.580*** (0.146)	7.914*** (0.0914)	8.336*** (0.0952)	8.700*** (0.105)	9.098*** (0.120)	9.419*** (0.122)	9.895*** (0.108)	10.58*** (0.173)
Observations	4,103	4,103	4,103	4,103	4,103	4,103	4,103	4,103	4,103

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table A4. Selection model

VARIABLES	(1) Dep. Var: Proc. Dummy
lab_prod (2yrs lag)	0.0388** (0.0188)
size_class	0.113*** (0.0370)
age	0.228*** (0.0384)
exporter	0.0271 (0.0699)
foreign	-0.188*** (0.0669)
family	-0.0944 (0.0694)
skill_ratio	0.523*** (0.186)
Constant	-5.867*** (0.314)
Observations	3,145
Country-Industry Effects	Y

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

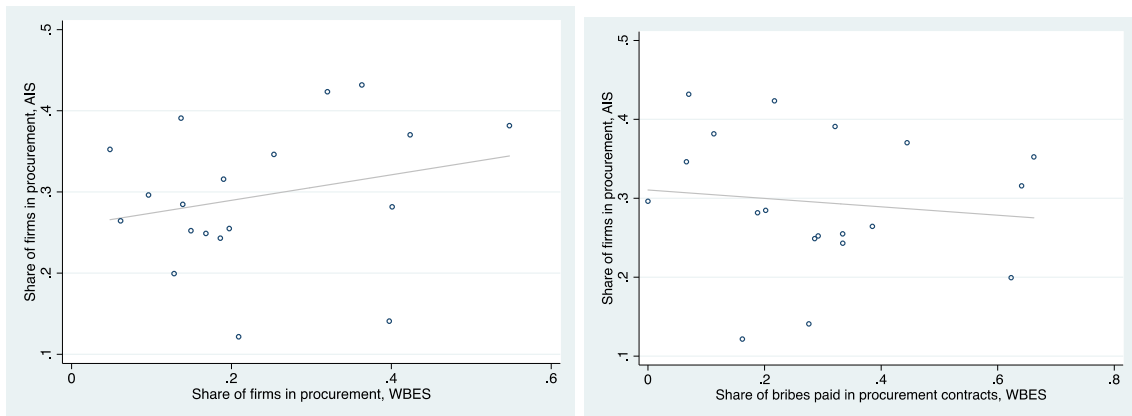
Table A5. Robustness & endogeneity

VARIABLES	(1) Weighted	(2) IV Expend/GDP	(3) IV PEFA/GDP	(4) IV Bribe/GDP
size_class	0.250*** (0.0416)	0.243*** (0.0288)	0.241*** (0.0289)	0.242*** (0.0289)
age	0.116*** (0.0402)	0.174*** (0.0304)	0.170*** (0.0305)	0.172*** (0.0304)
exporter	0.304*** (0.0781)	0.316*** (0.0556)	0.321*** (0.0555)	0.318*** (0.0556)
foreign	0.429*** (0.0746)	0.451*** (0.0527)	0.455*** (0.0526)	0.453*** (0.0528)
family	-0.153** (0.0772)	-0.272*** (0.0556)	-0.269*** (0.0556)	-0.271*** (0.0557)
skill_ratio	1.184*** (0.237)	1.158*** (0.145)	1.143*** (0.145)	1.152*** (0.146)
share_gov	0.360** (0.157)	0.429** (0.217)	0.652*** (0.219)	0.519* (0.277)
Observations	3,355	4,104	4,104	4,104
R-squared	0.279	0.121	0.120	0.121
Country fixed effects	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Figure A1. Share of firms in procurement, comparison between AIS and WBES data



Source: Authors' elaboration on UNIDO AIS and World Bank WBES

Figure A2. Distribution of IPW before (left panel) and after (right panel) weighting

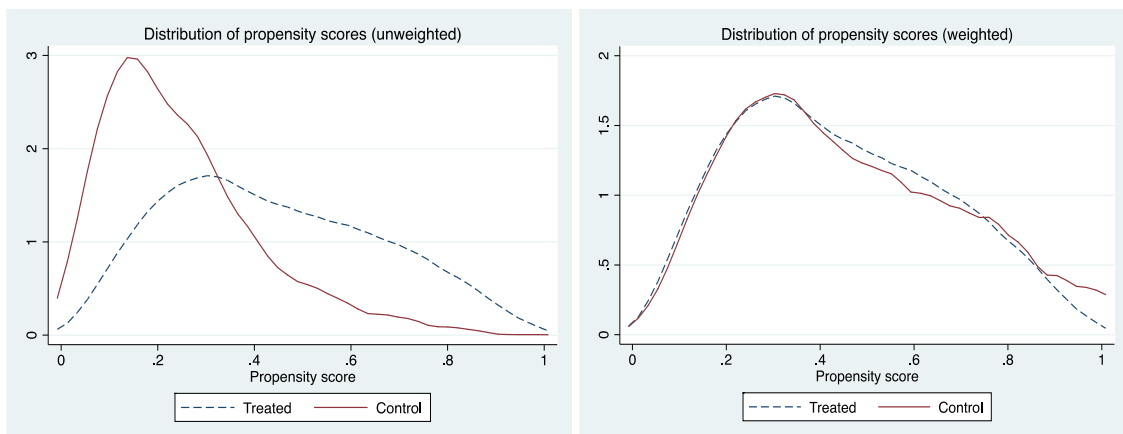
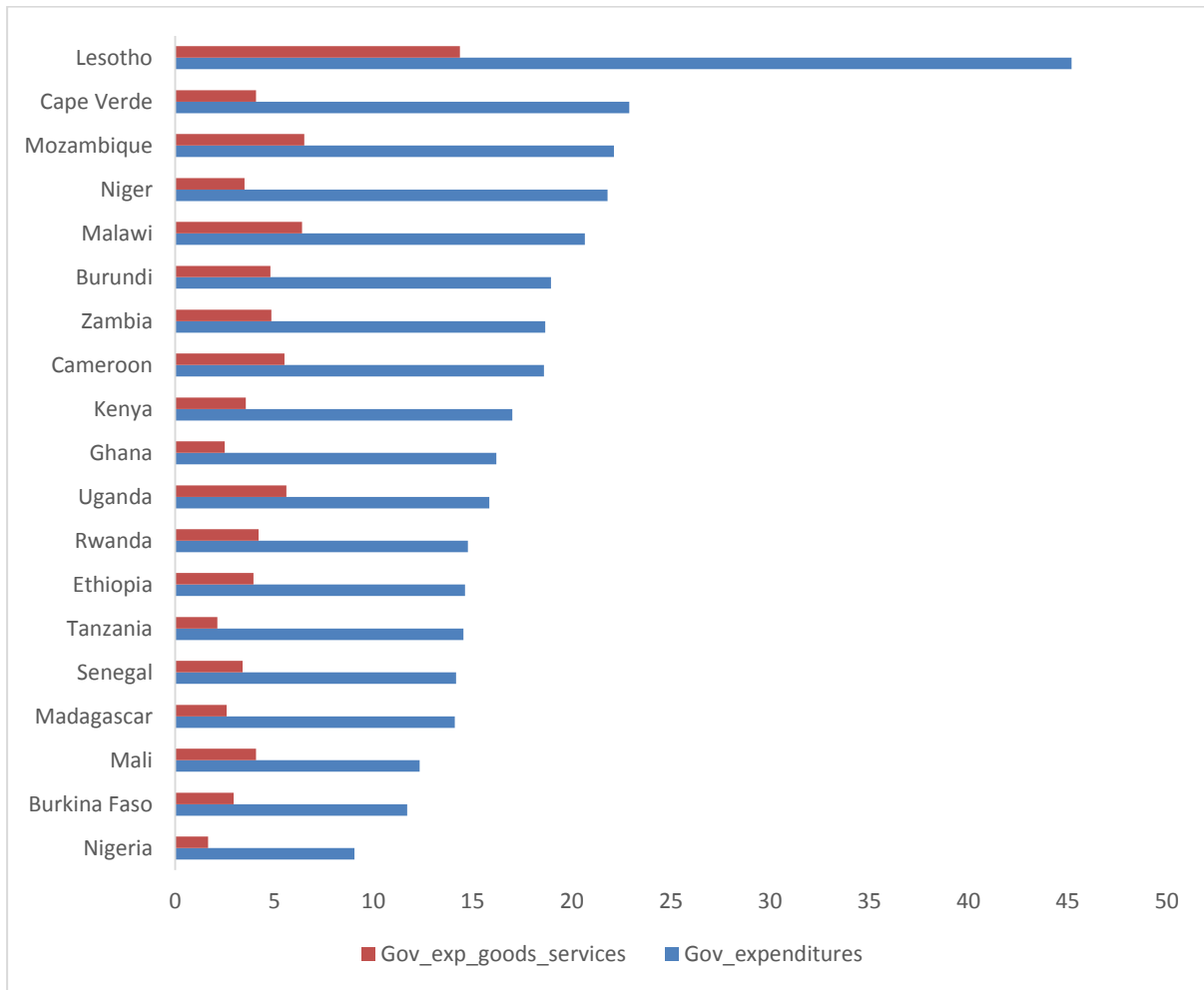


Figure A3. Government expenditures as a share of GDP (average 2006-2016)



Source: Authors' calculations based on IMF Government Finance Statistics.

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