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INNOVATION-FRIENDLY PUBLIC PROCUREMENT: A FIRM-LEVEL ANALYSIS FOR POLAND

The aim of the paper is to identify the drivers of innovation-friendly procurements. The research sample consists of 307 firms acting as contractors in public procurement in Poland. Our dataset has been constructed by utilizing data gathered in 2020 within the framework of the DIALOG 0260/20185 project, funded by the Ministry of Science and Higher Education. We apply the logit model with the propensity for innovation related to public procurement as the dependent variable and possible drivers of innovation-friendly procurement as the independent variables. Our main findings reveal significant distinctions between firms that introduced innovations related to public procurement and firms that did not, in particular with respect to firm size and scale of activity, orientation on public sector, and cooperation with the universities.

Keywords: Innovation, innovation activity of enterprises, public procurement, innovation policy.

1. INTRODUCTION

Public procurement means acquisition of goods and services by governments and state-owned firms. In recent years, public procurement has been regarded as a demand-side policy meant to spur innovation. An increasing shift of emphasis in innovation policy away from that supply-side instruments, e.g. R&D subsidies, to the demand-side incentives, e.g. innovative public procurement, is a phenomenon encountered in all EU Member States. In his seminal paper, Gerowski (1990) provided many arguments in favour of the use of public procurement to stimulate innovation and against over-relying on R&D subsidies. Despite increasing interest of authorities and policy-makers, there exists a very limited statistical evidence on the linkages between public procurement and innovation (Appelt and Galindo-Rueda, 2016). An excessive deficit exists in empirical studies on innovation-friendly

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procurement and its drivers. As suggested by Landerink et al. (2022), this type of public procurement may affect innovation to a greater extent than procurement of R&D services, due to lower financing and time needs.

To fill the gap in the literature, our study aims to identify the drivers of innovation-friendly procurements. The research sample consists of 307 firms acting as contractors in public procurement in Poland. Our dataset has been constructed by utilizing data gathered in 2020 within the framework of the DIALOG 0260/20185 project, funded by the Ministry of Science and Higher Education. We applied the logit model with the propensity for innovation related to public procurement as the dependent variable and possible drivers of innovation-friendly procurement as the independent variables. Our main findings show important differences between firms with innovations related to public procurement and firms without innovations related to public procurement, in particular with respect to firm size and scale of activity, orientation on public sector, and cooperation with the universities.

The remainder of the paper is structured as follows: the literature review section focuses on the link between public procurement and innovation, the following two sections present the methodology of research and the results, and the summary addresses limitations of the study and provides suggestions for future research.

2. LITERATURE REVIEW

In general, public or government procurement refers to the acquisition of goods and services by government or public sector organisations (Uyarra and Flanagan, 2010). It accounts for a considerable share of total demand for goods and addresses a complex set of social needs. Although the main goal of public procurement is to acquire goods and services of suitable quality that are essential for the operation of public entities and institutions, it may carry out other goals, including stimulation of innovation. Given the systemic approach to innovation process, firms' interactions with public institutions that purchase goods or order services may lead to new solutions. This is all the more important because innovations in the form of new or improved products or business processes play a crucial role in growth of organizations, regions, and countries. Public procurement has the potential to improve innovativeness, to stimulate innovation diffusion and, thus, to increase total factor productivity and economic development (Edquist, Hommen, 2000; Shin, Lee, 2022).

For a long time, public procurement has been considered as an innovation policy tool. For example, Rothwell and Zegveld (1981) found that R&D subsidies were less effective than public procurement in stimulating innovation. Several possible mechanisms of the impact of public procurement on innovation are discussed in the literature. As suggested by Cave and Frinkin (2003), there may be a direct or an indirect demand-pull impact. The former means a situation when the intention of a public institution is to procure innovative goods and services. In the nomenclature adopted by the European Commission (2014), this type of public procurement is called public procurement of innovative solutions and refers to procurements where contracting authorities act as a launch customer of innovative goods and services, which are not yet available on a large-scale commercial basis and may include conformance testing. In this case, public sector can be regarded as an experimental user. The latter is often referred to as innovation related to public procurement or innovation-friendly procurement. Unlike public procurement of innovative solutions, innovation-friendly procurement is not usually related to the development of new products or

technologies. In line with argumentation of Aschhoff and Sofka (2009), innovation can be regarded as a potential by-product of regular procurement. From the suppliers' point of view, innovation related to public procurement is desirable mainly for two reasons, including the enhancement of the value-for-money of procured products and services and the increase of competitiveness.

The growing interest in the use of public procurement as innovation policy tool is mainly due the fact that supply-side innovation policies (such as R&D public subsidies and tax incentives) are deemed to be insufficient to meet the current challenges in promoting competitiveness (Edler and Georghiou, 2007). However, as argued by Sánchez-Carreira et al. (2019) the innovation related effectiveness of procurement policies is also shaped by their interactions with other policy tools. Guerzoni and Raiteri (2015) put a particular emphasis on the phenomenon known as the 'hidden treatment', which tends to manifest when the results of a certain policy are affected by the concurrent application of other policies. Consequently, the influence of public procurement on innovation is assessed not only in isolation but also in conjunction with supply-push policies. The study by Caravella and Crespi (2021) suggested that the composition of policy measures is crucial, with their efficacy being enhanced when policy instruments targeting both the demand and supply sides are implemented concurrently.

Cabral et al. (2006) delineated three distinct forms of indirect impacts that public procurement exerts on innovation: first, by expanding the market for novel products; second, by easing the integration of new standards; and third, by changing the market structure in a manner that fosters a more innovation-friendly environment (dynamic effects). As argued by Mazzucato (2015), public sector funding contributes to much more than fixing market failures as it can push forward the boundaries of technologies, drive industrial renewal and structural change processes rather than just incentivizing or stabilizing existing markets or sectors.

Taking up innovation activities related to public procurement depends on several firms' characteristics. The key determinant of firms' propensity to innovate, when innovative activities are undertaken as part of a public procurement contract, is their size. The size of a company is frequently identified as the primary determinant for securing public procurement contracts (Blind et al. 2020). The empirical results suggest that procuring to the public sector is found to be associated with an increase in the probability of innovating in micro and small firms (Augliera, 2022). Micro and small enterprises can leverage public procurement as a strategic tool to alleviate their financial limitations or enhance their market reputation and credibility. This strategic positioning can, in turn, enable them to garner additional resources, paving the way for the pursuit of innovative projects. Small and medium enterprises (SMEs) especially have an important part in using public procurement to drive innovation (Geroski, 1990). However, as revealed by Uyarra et al. (2014) smaller firms face great difficulties with innovation related to public procurement contracts, connected for example with the size of contracts, the absence of constructive feedback or the ineffective dissemination of opportunities.

It can be also assumed that firms involved in public procurement contracts, especially those focused on innovation implementation, are expected to be more engaged in innovative activities and equipped with internal financial, human, and technical resources dedicated to R&D. As demonstrated by Georghiou et al. (2014), the level of firms' innovativeness determines their success in receiving public procurement contracts and delivering or bidding for public sector contracts contributes to increase of firms' R&D expenditures.

Moreover, prior experience in public procurement contracts is also important for innovation performance as firms may be better positioned to innovate due to familiarity with the process. Augliera (2022) provided a convincing evidence that engagement in public procurement in the past influences firms' innovative output in the future. For example, it may be expected that firms with past public contract experience have the capacity to anticipate contractors' requirements and adapt innovative solution to them.

The firm's propensity to innovate can be stimulated by the opportunities that may occur within public procurement contracts for collaboration between public sector entities and private firms. Participation in innovation systems strongly facilitates knowledge exchange and collaboration that induce innovations. Empirical studies reveal that firms profit from the collaboration with universities and research institutions. Moreover, a closer relationship with the procurer facilitates new knowledge acquisition, development of R&D, and induces collateral innovation. Divella and Sterlacchini (2020) hypothesised that the more firms are open to frequent interaction with different external actors and sources of knowledge (especially with potential public procurers), the higher the likelihood they will come up with innovations induced by public procurement contracts.

3. DATA AND RESEARCH METHODS

Our dataset has been constructed by utilizing data gathered in 2020 within the framework of the DIALOG 0260/20185 project, funded by the Ministry of Science and Higher Education. Employing the Computer-Assisted Telephone Interviewing (CATI) method, the investigation engaged a representative sample of 307 entities acting as contractors in public procurement in Poland. We have built the sampling frame of ordering entities and contractors involved in public procurement in 2018 on the basis of data

Table 1. Response and explanatory variables

No.	Variable name and its measurement	Symbol
Response variable		
1.	Introducing innovations as a result of the public sector contracts (1 if yes, and 0 if no)	INN
Explanatory variables		
2.	SME membership (1 if yes, 0 if no)	SME
3.	Number of completed public procurements	NPP
4.	Supply to the public sector (1 if supply to the public sector exceeds 30% of the total sale, and 0 otherwise)	SPU
5.	Experience in supply to the public sector (in years)	EPU
6.	Cooperation with the university (1 if yes, and 0 if no)	UNI
7.	Number of employees	EMP
8.	Service sector (1 if the company belongs to the service sector, and 0 otherwise)	SER
9.	Trade sector (1 if the company belongs to the trade sector, and 0 otherwise)	TRA
10.	Domestic market (1 if the company sells mainly in the domestic market, and 0 otherwise)	DOM
11.	International market (1 if the company sells mainly in the international market, and 0 otherwise)	INT
12.	Annual gross revenue (in PLN millions)	REV

Source: Own elaboration.

provided by the Public Procurement Office. Then, in order to identify firms carrying out innovation related to public procurement, we have created a binary variable equal to 1 if a firm has declared to have undertaken innovation as part of public procurement, and 0 otherwise. The set of explanatory variables consists of firm-related characteristics. Table 1 presents the description of the variables used in the analysis. The binomial logit model (Wooldridge, 2002), has been employed to study the link between public procurement and innovation.

4. RESULTS

Table 2 presents the descriptive statistics of all variables. Concerning the dependent variable in our analysis, 76% of companies declared the introduction of innovations as a result of the public sector contracts. The sample includes 77% SMEs. As regards the sectoral composition of the sample, 64% of companies were operating in the services sector, 17% in the trade sector, and 19% in the manufacturing sector. From the standpoint of market reach, 38% of enterprises sold their products or services in the local or regional market, 47% in the national market, and 15% in the international market. The employment in companies ranged from 1 to 1,500, and with the average of 114. The data shows that 63% of enterprises stated that their supply to the public sector exceeded 30% of the total sales. In turn, 21% of companies declared cooperation with universities. The gross revenue ranged from 0.1 to 35 million PLN, with the average of 11.4 million PLN. The average number of public sector contracts signed by enterprises was 119, while the average experience in implementing public sector contracts was 17 years. The largest number of contracts reached 6000 and the longest experience – 86 years.

Table 2. Descriptive statistics of variables

Variable	Mean	Std. dev.	Min	Max
INN	0.758	0.428	0	1
SME	0.771	0.420	0	1
NPP	119.12	595.04	0	6000
SPU	0.626	0.484	0	1
EPU	16.91	14.38	2	86
UNI	0.206	0.405	0	1
EMP	113,59	163,15	0	1500
SER	0.641	0.480	0	1
TRA	0.170	0.376	0	1
DOM	0.466	0.499	0	1
INT	0.152	0.359	0	1
REV	11.383	12.910	0.125	35

Source: own elaboration.

Table 3 presents the results of the logit model. Given the nonlinear nature of logit models, we report odds ratios, which are equal to 1 when there is a 50/50 chance that the event will occur with a small change in the independent variable. Negative coefficients lead to odds ratios lower than 1, whereas positive coefficients result in odds ratios exceeding the value of 1.

Table 3. Logit model estimates

Response variable: INN	Coeff.	Odds ratio
const	-2.931**	-
SME	1.901**	6.690
NPP	0.004	1.004
SPU	1.159***	3.187
EPU	-0.015	0.985
UNI	0.872*	2.392
EMP	0.004	1.004
SER	1.011	2.747
TRA	0.513	1.670
DOM	0.875*	2.400
INT	2.107**	8.221
REV	0.021	1.021
Likelihood ratio test (<i>p-value</i>)		33.195 (0,001)
Ratio of correct predictions		79.7%

Notes: *, ** and *** indicate significance at the 1%, 5% and 10% level.

Source: own elaboration.

First of all, the total prediction accuracy is 79.7%, which indicates that our model's performance is acceptable. What emerges from the estimates is that SMEs were more eager to introduce innovation related to public procurement than large firms. In general, the significant contributions of SMEs to innovation have been widely demonstrated in the literature (Odei, Hamplová, 2022). SMEs are seen as the most active and vibrant enterprises undertaking numerous innovative activities. Interestingly, our findings suggest that business ties with the public sector through sale affect innovation. In a more detailed way, firms which supply to public sector exceeds 30% of their total sales tend to be three-times more likely to introduce innovations as a result of the public sector contracts than the enterprises with a lower share. On the other hand, the number of completed public procurements and time experience in supply to public sector appeared to be insignificant in our analysis.

As regards other factors relevant to innovation-friendly procurement, it should be noted that cooperation with universities significantly increases the probability of introducing innovations (almost 2.5 times). Similarly, firms selling their products or services in the domestic market are 2.4 times more likely to introduce innovations than companies selling them in local or regional market, and this ratio is even higher for companies selling in the international market.

5. CONCLUSIONS

Public procurement is regarded as an attractive demand-side instrument for the implementation of innovation policy. It is important to notice that public procurement may stimulate innovation in private firms either directly or indirectly. The propensity of firms to engage in innovation activities for the purpose of public procurement depends on many factors. Our empirical analyses revealed that higher volume of sales to the public sector was associated with an increase in the probability of innovating. Moreover, we found that

SMEs and firms operating in domestic and international markets were more willing to introduce innovation related to public procurement than large firms and firms operating in a local market. Finally, it appeared that cooperation with university made firms more innovative. Given that Poland's business environment is primarily composed of micro and small enterprises, public procurement may serve as a policy instrument aimed at fostering their innovation performance. More specifically, policymakers should promote regulatory frameworks that explicitly allow for innovation, for example the adoption of procedures which enable negotiations with potential suppliers.

The pioneering nature of this study translates to some note-worthy limitations. First, we focused on innovation-friendly procurement, quite apart from the fact that there are other approaches to stimulate innovation through public procurement (e.g. procurement of R&D services). Second, the set of determinants of innovation related to public procurements is mainly limited to firms' characteristics. To overcome these limitations, future studies should consider other forms of public interventions that may complement innovation-friendly procurement. Moreover, they ought to extend analyses to a contractor's perspective.

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