Policy by Public Procurement: Opportunities and Pitfalls

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Till min familj

Abstract

This thesis consists of an introductory part and four self-contained papers all related to public policy by means of public procurement auctions.

In **Paper [I]**, we theoretically assess green public procurement (GPP) as an environmental policy instrument and its ability to lead to the achievement of environmental objectives. Central to our analysis is the extent to which polluting firms choose to adapt to the public sector's environmental requirements and to invest in greener technologies. Our main finding is that the potential of GPP to function as an objective-effective instrument of environmental policy is limited and can actually be counterproductive. From an environmental policy point of view, it is crucial that GPP aims for environmental standards beyond just the technology of the polluting firms and that it is designed with reference to defined environmental objectives.

In **Paper [II]**, we use data on Swedish public procurement auctions for internal regular cleaning service contracts to provide novel empirical evidence regarding GPP and its effect on the potential suppliers' decision to submit a bid and their probability of being qualified for supplier selection. We find only a weak effect on supplier behavior, and this suggests that GPP, as used in practice, does not live up to its political expectations. However, several environmental criteria appear to be associated with increased complexity, as indicated by the reduced probability of a bid being qualified in the post-qualification process. As such, GPP appears to have limited or no potential to function as an environmental policy instrument.

In **Paper [III]**, I examine how GPP is organized in Sweden and how the potential suppliers respond to varying buyer market shares using data on Swedish public procurement auctions for internal regular cleaning service contracts. The level of GPP stringency is found to vary systematically across authority types, buyer market share, and political coalition in the relevant council or in Parliament. The results also indicate quite a substantial dispersion in GPP stringency, suggesting a low degree of coordination among contracting authorities when implementing the policy. After controlling for GPP stringency and other covariates, increased buyer market share is associated with a significant increase in the probability of potential suppliers submitting a bid.

The European Commission encourages public authorities to split procurement contracts into multiple contracts in order to increase the competiveness of small and medium sized enterprises (SMEs). In **Paper [IV]**, I use data from Swedish public procurement auctions for internal regular cleaning service contracts to study the effect of contract size and number of contracts on SME participation and probability of winning. The results indicate that SME participation is negatively related to both contract size and the number of contracts in the procurement. A possible interpretation is that reduced contract size in order to stimulate SME participation is counteracted by reduced incentives for them to enter into procurements with multiple contracts. Medium-sized firms are also more successful when bidding for smaller contracts relative to large firms. Nevertheless, the results indicate that the award rate for SMEs is positively correlated with the number of contracts in the procurement.

Keywords: Public Procurement Auction, Environmental Policy, Regulation, Sustainability, Competition, Compliance Cost, Endogenous Entry, Supplier Incentives, Buyer Market Share, Split Award, Small and Medium Sized Enterprises

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Elon
Umeå, April 2015

This thesis consists of a summary and the following self-contained papers:

[I] Lundberg, S., Marklund, P-O., & Strömbäck, E. (2014). Is Environmental Policy by Public Procurement Effective? *Public Finance Review*, 1-22, DOI: 10.1177/1091142115588977. (Reprinted with permission).

[II] Lundberg, S., Marklund, P-O., Strömbäck, E., & Sundström, D. (2015). Using public procurement to implement environmental policy: an empirical analysis. *Environmental Economics and Policy Studies*, 1-34, DOI: 10.1007/s10018-015-0102-9. (Reprinted with permission).

[III] Strömbäck, E. (2015). The Role of Buyer Power in Public Procurement Auctions: An Empirical Analysis. *Umeå Economic Studies*, No. 913.

[IV] Strömbäck, E. (2015). Contract Size and Small Firm Competition in Public Procurement. *Umeå Economic Studies*, No. 914.

1. Introduction

This thesis consists of four self-contained papers that evaluate public procurement as an instrument of environmental policy and for providing business opportunities for small and medium sized enterprises (SMEs). In particular, I study the potential of green public procurement (GPP) to achieve reduced environmental damage by creating incentives for brown suppliers to invest in becoming more environmentally friendly. In addition, I study the effect of procurement design on SME participation and the probability of being awarded the contract.

A public authority can either choose to provide a publicly funded welfare service through in-house production or through entering into a contract with a private supplier (McGuire et al., 1987; Christoffersen et al., 2007). The latter production mode is typically preceded by a formalized procurement procedure in which potential suppliers are invited to compete for the public contract through a letting process.

The letting procedure within the EU is generally carried out by means of a descending bid auction in which potential bidders are invited to enter a sealed bid in accordance with the specification in a so-called call for tender. The publicly advertised call for tender includes a detailed specification of mandatory criteria to be fulfilled by the bidders, contractual terms, and the supplier selection method (see, e.g. Bergman and Lundberg, 2013). Potential bidders respond to the call for tender by choosing whether or not to submit a bid. A bid for a given call for tender comprises a set of documents detailing how the criteria in the specification are to be fulfilled along with a price bid.

After the letting date falls due, the contracting authority evaluates all received bids according to the criteria specified in the call for tender. Only bids that meet each mandatory criterion are qualified for supplier selection on the basis of either the lowest price or the most economically advantageous tender (MEAT).[1] The designated winner of each contract typically receives a fixed price throughout the contract period in accordance with their price bid.

In addition to serving as a mechanism to allocate resources among a group of bidders, public procurement is quite often seen as a means for achieving political objectives. For example, public procurement has been used in the US to address social issues such as labor standards, unemployment, employment opportunities for disabled workers, racial equality, affirmative action programs, and set-asides for businesses owned by minorities (McCrudden, 2004). Similarly, public procurement has also been used to promote domestic firms (McAfee and McMillan, 1989) and disadvantaged groups of firms (Krasnokutskaya and Seim, 2011).

In more recent times there has been a rapid increase in the use of GPP, in which the public sector stipulates environmental criteria in addition to price and other quality attributes when contracts are allocated to private suppliers. The environmental criteria may specifically refer to emission targets or

[1] MEAT implies that all qualified bids are ranked according to a multidimensional scoring rule including price and other quality attributes (Asker and Cantillon, 2008; 2010; Bergman and Lundberg, 2013; Hyytinen et al., 2015).

to certain aspects of the supplier's production technology (Lundberg and Marklund, 2011). In particular, the European Union (EU) and its member states are very clear in their ambitions to use GPP as an environmental policy instrument (European Commission, 2008b; Tukker et al., 2008), and similar initiatives can be found, for example, in the US (Environmental Protection Agency, 1990, 1991; McCrudden, 2004; Fischer, 2010) and China (Geng and Doberstein, 2008; Qiao and Wang, 2011). The heart of the arguments for using public procurement as a policy instrument is that the public sector should use its buyer power to influence, or "pull", industries in directions that are perceived as beneficial for society and as such contribute to local, regional, national, and international sustainability goals (European Commission, 2011a; Marron, 2003; Edler and Georghiou, 2007; Albano and Sparro, 2010). Indeed, public procurement amounts to a significant part of the economy in many parts of the world. In the EU, public sector purchases of goods, works, and services through competitive tendering are estimated to account for 16% of the EU's GDP (European Commission, 2008b).

Other procurement policies currently in use aim towards increased participation and more contracts being awarded to small and medium sized enterprises (SMEs). Textbook examples of how to design a procurement auction to encourage entry from disadvantaged potential bidders include bid preference programs, set-asides, and the practice of splitting the procurement into multiple contracts, which is referred to as a split award (Milgrom, 2004). A bid preference program can involve giving disadvantaged bidders a price preference in the supplier selection process (see e.g. McAfee and McMillan, 1989; Marion, 2007; Krasnokutskaya and Seim, 2011). A set-aside policy is implemented by setting aside a fraction of contracts for targeted firms, and a bidder is typically not eligible to win more than one contract (Milgrom, 2004; De Silva et al., 2012). The European Commission encourages the contracting authorities to use split awards to increase SMEs' participation in the auction and their chances of winning (European Commission, 2011b; 2012).

Despite the frequent use of public procurement to achieve environmental and distributional objectives in society, the mechanisms for how such an effect may be achieved are still poorly understood. This thesis focuses on the ability of public procurement to achieve environmental objectives and to create business opportunities for SMEs.

By examining GPP's ability to incentivize potential suppliers to invest in less environmentally damaging technology and to submit a bid, this thesis contributes with theoretical predictions of the policy's potential to achieve environmental objectives. This thesis also provides novel empirical evidence on the topic by using self-contained data on Swedish public procurement auctions for internal regular cleaning service contracts. Additional information about the contracting authorities, potential bidders, and regional markets was retrieved from Statistics Sweden. The unique and very detailed data enabled us to carry out detailed and comprehensive studies on the potential supplier's response to public procurement as a policy instrument.

GPP's potential to achieve reduced environmental damage by creating incentives for brown suppliers to adapt to environmental criteria is studied theoretically in Paper [I]. Our main finding is that the potential of GPP to function as an objective-effective instrument of environmental policy is limited and can actually be counterproductive. In Paper [II] we empirically examine the effect of different environmental criteria or standards on the potential bidder's entry decision and qualification into public procurement auctions. We find at best a weak effect on the supplier's behavior suggesting that the use of GPP does not live up to its political expectations in this context. Nevertheless, environmental standards are associated with increased complexity as indicated by the reduced probability of a qualified bid. In Paper [III], I present empirical evidence on the role of buyer power in public procurement auctions by examining how GPP is organized in Sweden and how the potential bidders' entry decision is affected by varying buyer market shares. The results indicate that implementation of GPP is uncoordinated across different public authorities. In addition, increased buyer market share is shown to increase the incentives for potential bidders to enter into the auction. Paper [IV] empirically studies the effect of splitting the procurement into multiple contracts of limited scope with the purpose of stimulating SME participation and the likelihood of their winning the contract. The results indicate that contract size and the number of contracts are important determinants for SMEs' probability of entry and of winning the contract.

2. Using public procurement auctions as an environmental policy instrument

There is widespread concern about the current state of the environment and the limited success of existing policies to prevent environmental degradation. Although GPP appears to be a well-established environmental policy instrument, it is not well studied in the academic literature and, as pointed out by Testa et al. (2012), it is still a relatively new area of research. Empirical studies on the topic have sought to identify determinants for the various contracting authorities' use of GPP criteria, often referred to as GPP uptake (see, for example, Walker and Brammer, 2009; Palmujoki et al., 2010; Testa et al., 2012). Information campaigns, e-procurement, communication with suppliers, and education of civil servants are typically indicated in these studies to be associated with increased probability of using environmental criteria in the call for tender.

Several studies have also described national GPP initiatives (e.g., Swanson, 2005; Bolton, 2005; Geng and Doberstein, 2008; Ho et al., 2010; Arvidsson and Stage, 2012) or provided guidelines (e.g., Parrika-Alhola, 2008; Tarantini et al., 2011), but none of these studies have provided a theoretical or empirical understanding of how GPP works as an environmental policy instrument.

A related branch of the literature has focused on GPP's potential to foster innovation. Procurement decisions are made by numerous distinct authorities – including municipalities, county councils, public enterprises, and central governments. Several studies have discussed the decentralized structure of GPP and actions that may increase the potential suppliers' incentives to invest in greener technology

(see, for instance, Marron, 2003; Edler and Georghiou, 2007; Albano and Sparro, 2010). The public sector's buyer power is argued to be an important factor for industry innovation and can either stem from the sheer size of a single purchase or from coordinated actions across several contracting authorities. There is, however, a lack of empirical research that has studied the organization of GPP and the potential suppliers' response to varying buyer market shares.

3. Evaluation of environmental policy instruments

From a welfare economic point of view, the environmental degradation due to excessive pollution or overexploitation of natural resources is the consequence of a market failure. That is, the environmental damage associated with production or consumption is not properly reflected in the market price of the product (see, for instance, Baumol and Oates, 1988).

The wide array of existing policy instruments to regulate such failures can broadly be categorized into command-and-control or economic instruments (Hanley et al., 2007). From an environmental policy point of view, it is crucial that the preferred instrument aims for an environmental standard beyond just the technology of the polluting firms and that it is designed with reference to defined environmental objectives. A socially optimal level of abatement is translated in command-and-control instruments into uniform quotas or performance standards for the production technology. Economic policy instruments, on the other hand, are commonly referred to as being market based. By adding in the cost of the environmental damage, the polluting market participants are encouraged to take the externalities associated with production into account, resulting in reduced emission levels. Examples of such economic policy instruments are emission taxes, subsidies of abatement technology, and tradable permits (Tietenberg, 1990).

A given policy instrument can, among other things, be judged on the basis of cost-effectiveness and objective-effectiveness (see e.g., Hanley et al., 2007). Cost-effectiveness refers to the extent to which a given abatement target is achieved at the lowest possible cost to society. Common to command-and-control instruments such as the uniform performance standard is that they are inflexible and thus not a cost-effective means for achieving the abatement target whenever the marginal abatement cost differs among the market participants. This is often the case when the market participants are heterogeneous in their production technology. Economic instruments, on the other hand, rely on the market mechanism to allocate the abatement target among the participants in the market. The price signal renders a cost-effective outcome given that the market participants choose their profit-maximizing level of abatement.

In thinking about the functioning of GPP, the use of uniform mandatory criteria in terms of performance standards to be fulfilled by the potential suppliers means that the policy shares common traits with command-and-control instruments. Along that line, Lundberg and Marklund (2013) argue that GPP is not a cost-effective environmental policy instrument when the brown potential suppliers

are heterogeneous in their environmental performance prior to the procurement auction. This argument follows from the EU procurement directives of non-discrimination and equal treatment, which prevent the contracting authorities from customizing the environmental criteria in accordance with supplier-specific marginal abatement costs. A cost-ineffective policy instrument, however, can still be the preferred policy instrument if it has a real impact on the environment, which in turn is related to objective-effectiveness.

Objective-effectiveness refers to the potential of an environmental policy to actually achieve the objectives it aims for. By taking into account the market reactions from private consumers and producers, Marron (1997) touched upon GPP and objective-effectiveness when the public sector changes from buying conventionally produced products to greener, less polluting, off-the-shelf products. A procurement policy that changes the composition of public sector purchasing may lead to private consumers changing their purchases in response, and this could result in increased emissions from private consumption. For example, in the standard case of upward sloping supply curves, GPP results in a price increase of the green product that, all else being equal, will induce a counteracting effect from private consumers. The policy is predicted to be more successful at reducing environmental impact in procurement sectors where *i*) the public sector has a large market share in both the brown and the green market, *ii*) the supply is elastic in both markets, and *iii*) the private demand is inelastic in both markets.

A crucial feature of GPP is the option for the brown potential suppliers to make the necessary adaptions of their production technology and enter into the bidding process. However, complying with the mandatory criteria, learning the cost of fulfilling the contract, and preparing the necessary bid documents is a costly activity for potential bidders, and the payoff is uncertain (Samuelson, 1985; Levin and Smith, 1994; Krasnokutskaya and Seim, 2011). The potential bidders can avoid the adjustment cost by simply refraining from participating in the procurement auction and instead competing for the residual demand in the market not covered by the environmental standard specified in the call for tender. The entry decision makes GPP potentially weaker than taxes, tradable permits, subsidies, and industry standards, although any form of environmental regulation can lead to entry barriers (see, e.g., Heyes, 2009 for a survey).

4. Disadvantaged potential bidders in public procurement

There is a vast body of literature within the field of auction theory seeking to establish the effect of different procurement auction policies on participation and bidding. For instance, the discriminatory policies of bid preference programs and set-asides are commonly used for the purpose of creating business opportunities for disadvantaged firms. A disadvantaged firm is less cost-efficient at fulfilling the contract, and a discriminatory policy may in such circumstances level the playing field across firm

categories. Increased competitiveness of the disadvantaged firms is expected to increase their participation and their probability of being awarded a contract.

Empirical evidence from auction data suggests that the discriminatory policies of bid preference programs and set-asides can shift contract awards to the favored category of, for example, small firms at little or no cost to the contracting authority (see e.g. Marion, 2007; Krasnokutskaya and Seim, 2011; De Silva et al., 2012). Nevertheless, no previous studies have, to my knowledge, empirically assessed the importance of contract size and the nondiscriminatory practice within the EU of splitting the procurement into multiple contracts with the purpose of creating business opportunities for SMEs.

When evaluating GPP's ability to transform industry and the ability of procurement design to induce SME participation and contract award, it is important to take into account the potential supplier's entry decision. The next section discusses the entry decision of the potential bidders in more detail.

5. Endogenous entry in procurement auctions

Public procurement has received significant attention within the auction-theory literature, starting with the seminal papers by Vickrey (1961) and Harsanyi (1967). In the independent private value paradigm, a bidder i is assumed to know their own (private) cost parameter, c_i, for the contract but only the distribution $F(c)$ on the support $[\underline{c}, \overline{c}]$ from which its *N-1* potential competitors' costs are drawn.[2] In the Bayesian Nash equilibrium, a bidder with a given private cost parameter chooses an optimal price bid, $b_i = b(c_i)$, such that the expected profit in the auction is maximized. Early models of auctions and bidding were static in the sense that they did not consider entry, and comparative statics from these models predicted that the bid-cost margin is strictly decreasing along with the number of potential bidders.

With non-negative entry costs and endogenous entry, this no longer needs to be the case. Novel models of entry include those of Samuelson (1985) and Levin and Smith (1994). In both models, entry is assumed to be costly due to the process of learning the private cost parameter associated with carrying out the contract and the cost of preparing the necessary bid documents. The two models of entry differ only in the timing of when the information about the bidder's private cost parameter is known, which has consequences for the subsequent screening of potential bidders.

When the private cost parameter, c_i, is assumed to be known prior to the entry decision, bidders are modeled to adopt a pure strategy (Samuelson, 1985). In the pure strategy equilibrium, exactly n bidders enter the procurement auction and $N - n$ stay out. This implies that the typical firm will not

[2] Other informational assumptions about the firms' cost parameter are that the cost is the same for all firms, but is unknown at the time of bidding, or that the cost is affiliated (see, e.g., Menezes and Monteiro, 2005). The assumption of common cost, or values, is usually applicable to oil-lease auctions and auctions for snow removal contracts (see, e.g., Kagel and Levin, 1986). Affiliated costs, or values, imply that the cost parameter is positively correlated across bidders (Li et al., 2002). This informational structure may be motivated when there is a secondary market for the auctioned object.

participate if the firm's cost is above some cut-off cost, $c \in (c^*, \overline{c}]$. A firm with a private cost equal to the cut-off cost c^* is indifferent to participating with a bid of b^* or staying out of the procurement auction. Expressed more formally, the expected net profit from bidding for a firm with a private cost c^* is

$$E(\pi) = [b^* - c^*][1 - F(c^*)]^{N-1} - k = 0, \quad (1)$$

where $[b^* - c^*]$ is the bid-cost margin, $[1 - F(c^*)]^{N-1}$ denotes the probability that the firm with cut-off cost c^* is the only competing bidder, and k is the non-negative entry cost.

The equilibrium threshold cost c^* serves as a self-regulating mechanism that screens for low-cost bidders. Thus the pure strategy equilibrium produces a truncation of the cost distribution to the left, i.e. high-cost firms do not undertake wasteful entry costs due to the low likelihood of them being awarded the contract. Equation (1) summarizes the equilibrium entry condition and leads to the following comparative static result: all else being equal, c^*, and therefore $F(c^*)$, are decreasing in the entry cost, k. Consequently, the typical firm enters less frequently as the entry cost increases (Samuelson, 1985; Li and Zheng, 2009).

In the context of GPP, the entry cost can take into account supplier-specific compliance costs of having to adjust to stringent environmental criteria, less any profits from selling the green products to the private market. This is likely to limit the environmental policy's potential to target firms with poor environmental performance and high adjustment cost, as is discussed in Paper [I] and tested empirically in Paper [II]. Furthermore, Paper [III] contributes to the previous literature on endogenous entry into procurement auctions by assessing the effect of buyer market share on the potential supplier's incentives to enter into the bidding process (see, for instance, Jofre-Bonet and Pesendorfer, 2000; 2003; Li and Zheng, 2009; Krasnokutskaya and Seim, 2011). Paper [IV] tests for heterogeneity in expected profitability across firm size categories related to contract size and number of contracts.

6. Summary of the papers

Paper [I]: Is environmental policy by public procurement effective?

Objective-effectiveness refers to an environmental policy's potential to actually achieve the objectives it aims for (Hanley et al., 2007). In Paper [I], we expand on Marron's (1997) work by analyzing to what extent GPP results in effective reduction of emissions by asking the brown (or conventional) suppliers to comply with stringent environmental criteria and submit a bid for public contracts. Marron's (1997) model can be described as a *substitution policy* where the public sector switches from buying a conventionally produced product to a less-polluting off-the-shelf product. The net effect on total emissions will likely not be one to one due to the private market response to changes in relative prices. In fact, private consumers of the green product will tend to respond to the substitution policy by switching to the conventionally produced product. The policy is predicted to be

more successful at reducing environmental impact in sectors where *i*) the public sector has a large market share in both markets, *ii*) the supply is elastic in both markets, and *iii*) the private demand is inelastic in both markets.

Market supply of conventional and green products is, in Marron's (1997) paper, assumed to be fixed, and the model does not take into account the procurement process of competitive tendering for public contracts. We therefore introduce a *transformation policy* where the public sector strives to exert direct control or influence over potential suppliers' investments in greener production processes and/or products by the means of a GPP policy that aims for a pre-specified environmental objective. This could be a situation in which the producer of a conventional product invests in new production processes and starts to produce for the green product market instead. We also include a comparison of the substitution and transformation policy and what policy is better from a resource allocation perspective. In addition to this, our theoretical findings are illustrated with an empirical example. Specifically, the Swedish government has proposed a target that 20% of the arable land in Sweden be certified for organic agriculture, and the public sector's purchase of food is officially seen as a means to achieve this objective. The ambition is that 25% of the food purchased should be organically grown. This requires the public sector to re-distribute its' food basket and to substitute conventional for organically grown and produced food.

Our overall conclusion is that the potential for GPP to function as an objective-effective instrument of environmental policy is limited. Even though the transformation policy in comparison with the substitution policy drives the prices in the politically desirable direction, both policies have the same outcome in terms of production and emissions. In fact, the transformation policy can, just like Marron (1997) predicted for the substitution policy, have a counteracting effect on total emissions.

A transformation policy is not an objective-effective policy instrument due to the potential suppliers self-selecting for the GPP. More specifically, the cost for a conventional supplier to adjust its production technology to environmental criteria can be folded into the entry cost, k, in Equation (1). The increased entry cost will, all else being equal, result in reduced participation. Hence, the entry mechanism inherent to GPP does not provide incentives for the worst-performing potential suppliers to adjust their production technology to stringent GPP criteria and to enter into the auction. Therefore, the transformation policy's ability to achieve a given environmental objective is most likely weaker than more traditional policy instruments. The political argumentation in favor of GPP policy is thus not consistent with how the market reacts to it.

Paper [II]: Using public procurement to implement environmental policy: an empirical analysis

In Paper [II] we provide novel empirical evidence regarding GPP and its effect on a potential supplier's decision to submit a bid, the degree of competition, and the likelihood of a bid being qualified. In particular, we study how potential heterogeneity in the probability of entry and qualification is related to firm size.

The data were extracted from Swedish authorities' procurements of internal regular cleaning services from the years 2009 and 2010. For the 337 procurements, we have information about the type of authority, the procurement design, the object or facility to be cleaned, contract and local market characteristics, all submitted bids, and whether or not a bid met all of the mandatory qualification criteria. The data also provide rich descriptions of the environmental criteria that are stipulated in each of the procurements. In total, we can identify 28 different environmental criteria. Because several of them are simply different ways of describing the same environmental dimension, the criteria are sorted into six different green categories. The data also describe the environmental dimension that the criteria aim to influence, such as environmental management systems, vehicles, and the use of chemicals, as well as other quality demands within the procurement.

To assess the market reaction to GPP policies, it is essential to explore the firm-level decision to participate in the GPP process – as well as the aggregate number of bidders – and to relate this to procurements (contracts) with various environmental criteria. The cost to adapt to environmental criteria may differ among the potential suppliers depending on whether they have already made environmental investments or not, i.e., there may be systematic *a priori* cost asymmetries in adapting to the criteria. GPP policies may, therefore, give "greener" suppliers competitive advantages that induce them to participate to a greater extent. Consequently, the expected net profit in Equation (1) of entering the procurement auction will vary across potential suppliers. A potential supplier will submit a bid when the underlying continuous expected net profit function is non-negative. The underlying expected net profit in Equation (1) is not directly observed, but the binary outcome variable to participate in the auction is observed. Hence, the participation decision is assumed to be a function of supplier-specific characteristics, contract characteristics, and procurement characteristics.

From an environmental policy point of view, it is important that the contracting authority specifies transparent and adequate environmental criteria according to some predetermined environmental objective. The misunderstanding of criteria by potential suppliers is associated with a risk of them deciding not to submit a bid or of them undertaking non-optimal green investments, and this potential problem is the motivation for analyzing the relationship between the GPP design and the qualification process. Specifically, the probability of a bid becoming qualified in the post-qualification process serves as a proxy for the complexity of the procurement (Wan and Beil, 2009). The selection rule is assumed to be a function of supplier-specific characteristics, contract characteristics, and procurement characteristics.

Our main findings are that the design of GPP, i.e., the different categories of environmental criteria, has only limited impact on the suppliers' decisions to participate in the process and on the aggregate number of bids. There is also no evidence of systematic self-selection into procurements of different categories of environmental criteria related to firm size. As such, GPP appears to have limited or no potential to function as an environmental policy instrument in this context.

The qualification process reveals that GPP is associated with increased complexity as indicated by the reduced probability of a bid becoming qualified, particularly when environmental management systems or regulation of chemical use are the criteria. Therefore, we find no general support for the political expectations of GPP to be an environmental policy instrument.

Paper [III]: The role of buyer power in public procurement auctions: an empirical analysis

Advocates of public policy by means of GPP argue that the public sector can use its buyer power to incentivize industries into becoming less environmentally damaging. In Paper [III], I examine how GPP is organized in Sweden and the potential suppliers' response to varying buyer market shares using data on Swedish public procurement auctions for internal regular cleaning services.

In the European Union, public procurement of goods, works, and services are estimated to account for 16% of the GDP (European Commission, 2008b). It must be emphasized, however, that this crude estimate of buyer market share aggregates procurement decisions made by numerous distinct authorities – including municipalities, county councils, public enterprises, and central governments – over several product and service categories. Hence, full utilization of the public authorities' buyer power potential in a given sector may require demand coordination, either implicitly through a low degree of heterogeneity in buyer preferences or explicitly through standardization across different contracting authorities (Marron, 2003; Edler and Georghiou, 2007; Albano and Sparro, 2010).

This, of course, limits the scope for a flexible GPP design in accordance with the structure of the relevant market or the contracting authority's idiosyncratic preferences and their valuation of local externalities in production (Marron, 2003; Albano and Sparro, 2010). Hence, there is a potential tradeoff between market power through coordinated demand on the one hand and flexibility on the other.

This paper uses field data on 725 internal regular cleaning contracts awarded by 176 distinct Swedish contracting authorities to study the implementation of GPP across the various contracting authorities and the effect of buyer market share on the potential supplier's incentives to enter the bidding process. Internal regular cleaning contracts make a good testing ground because these are highly homogenous services that are both produced and consumed locally and because they are a basic necessity in both the public employment sector and the private employment sector. These characteristics are utilized when constructing the proxy variable of buyer market share, which is defined as the share of the workforce in the regional market being employed by the public authority. In addition, a simple index of GPP stringency is constructed by aggregating the 28 unique environmental

criteria in the data into a single index (see, for instance, De Silva et al., 2009; 2012). The index of GPP stringency is used for exploring possible systematic differences in the organization of GPP across contracting authorities and regional markets with different buyer compositions.

Among the results, a count regression with GPP stringency on buyer market share and other observable buyer characteristics indicates heterogeneity in the level of GPP stringency related to authority type and buyer characteristics. Specifically, a high level of GPP stringency is used more often in regional Swedish markets where the contracting authority type has a large buyer market share and when the Swedish Green Party holds the balance of power in the relevant council of the contracting authority or in the Swedish Parliament.

Uncoordinated implementation of GPP among contracting authorities makes it possible for potential suppliers to substitute public and private contracts with less stringent GPP criteria. This may weaken the ability of policy makers to provide the potential suppliers with real incentives to comply with the GPP criteria. Results from a cross-sectional analysis of GPP dispersion as a function of public buyer composition suggest that the organization of GPP is less dispersed (i.e. there is a higher degree of demand coordination) in more concentrated markets in terms of authority types.

Consistent with theoretical predictions, logit estimates suggest a positive significant direct effect from increased buyer market share on the probability of potential suppliers submitting a bid. The effect persists even after taking into account the indirect effect of buyer market share mediated by GPP stringency. The result thus supports the arguments that buyer market share is an important determinant for the ability of the purchasing policy to contribute to reduced emissions.

Paper [IV]: Contract size and small firm competition in public procurement

The European Commission acknowledges that SMEs are underrepresented when it comes to bidding for and being awarded public procurement contracts. Splitting the procurement into multiple contracts of limited scope, which is referred to as a split award, is expected to induce SMEs' likelihood of participation and winning (European Commission, 2011b; 2012). In this paper, I evaluate the importance of contract size and the number of contracts in the procurement on SME participation and winning.

The potential of split awards to induce SME participation and increase the probability of winning the contract has, to my knowledge, not been studied empirically before. Previous studies on split awards have mainly focused on assessing the effect on auction clearing price in highly complex and often incomplete procurement projects with learning effects and diseconomies of scale (see, for instance Lyon, 2006). The current procurement segment of internal cleaning service contracts is associated with a relatively non-complex and labor intensive production technology and is not likely to exhibit any substantial learning effects over time (Hyytinen et al., 2015).

This paper contributes to the literature on procurement programs that seek to encourage entry and winning by disadvantaged potential bidders. Examples of such policies include bid preference

programs and set-asides (Milgrom, 2004). A bid preference program can involve giving disadvantaged bidders a price preference in the supplier selection process (see, for example, McAfee and McMillan, 1989; Marion, 2007; Krasnokutskaya and Seim, 2011). A set-aside policy is implemented by setting aside a fraction of contracts for targeted firms, and a bidder is typically not eligible to win more than one contract (Milgrom, 2004; De Silva et al., 2012). Results from the empirical literature indicate that bid preference programs increase participation by the favored bidder category of, for example, small firms and their probability of winning the contract at the expense of decreased participation and award rate for the non-favored category, in this case large firms (Marion, 2007; Krasnokutskaya and Seim, 2011).

A potentially limiting effect of split awards on SME participation and winning is the lack of restrictions on the number of contracts an efficient supplier can be awarded. Hence, the procurement policy enables the bidders to internalize expected economies of scale, or synergy effects, in their stand-alone price bids *across* contracts within the procurement. This may offset, partially or in whole, the ambition set out by the European Commission to support SMEs through splitting the procurement over multiple contracts.

The bidding firms in the data are categorized into small, medium, and large firms based on their number of employees. The effect of procurement design on the outcome variables of interest is analyzed using cross-sectional variation in contract size and the number of contracts in the procurements under study. Results from 331 procurements comprising 634 contracts confirm substantial heterogeneity in participation rates and award probability across firm size categories related to contract size and number of contracts. Linear probability model estimates on the potential bidder's entry decision indicate that large firms to a greater extent self-select into large contracts and procurements with multiple contracts. Conditional upon bidding, the award rate for small bidders is not affected by contract size. In contrast, medium-sized bidders are more successful when bidding for smaller contracts relative to large bidders. The analysis also indicates that SMEs' award rate is positively correlated with the number of contracts in the procurement. The results in this context thus support the practice used within the EU of splitting the procurement into multiple contracts in order to provide business opportunities for SMEs.

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