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4.1.1.

Green and Sustainable Public Procurement

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Executive summary

This policy brief explores the critical role of Green Public Procurement (GPP), focusing on the ongoing research activities conducted by three university research groups. The authors present their findings and insights into the adoption and impact of GPP in Italy.

One research line studies the current state of the art and the adoption of GPP at the national level, considering the recent adoption of minimum environmental criteria (CAM, or "Criteri Ambientali Minimi" in Italian). The promotion of GPP by public authorities in Italy is analyzed, focusing on the sector of school canteens: researchers identify keywords, analyze tender characteristics and propose a novel "*degree of greenness*" indicator. They also extend their analysis to regulations similar to CAMs adopted in other EU countries.

One work exploits a discontinuity in the characteristics of the public buyer which can be used for studying the adoption of GPP. It investigates qualitative and quantitative elements in green procurement tenders, analyzing information on all the tenders awarded by local municipalities to assess greenness impact on the awarding and execution phases. In particular, the use of AI is proposed to systematically analyze textual information in procurement documents, allowing for a more precise understanding of the greenness of public contracts and award mechanisms.

A different research strand merges different sources of firm-level data to explore how SMEs' entry into public procurement is influenced by green and sustainable procurement rules. In particular, it examines the Legality Rating to understand the impact on sustainable practices among SMEs.

The outcome will provide policymakers with empirical evidence aimed at enhancing the efficiency and effectiveness of public tenders while promoting sustainability goals. It emphasizes the importance of efficient and strategic procurement for achieving economic growth, environmental sustainability, and social inclusivity. It suggests that policy interventions should consider the characteristics of SMEs, encouraging innovation and providing support to bridge the gap in meeting sustainability standards. Recommendations include flexible Legality Ratings for SMEs, avoiding penalization, and introducing preferential treatment for SMEs in public tenders.

These works underline the importance of public data availability for analyzing sustainability issues. It suggests integrating existing public databases with artificial intelligence to enhance the classification of green procurement and promote data-driven policy-making.

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1. Presentation and description of the research activity undertaken

Public authorities in the European Union (EU) award contracts for services, works and supplies worth around 14% of EU GDP (equivalent to around €2 trillion annually). By assessing the environmental quality of bids when awarding public contracts (i.e. Green Public Procurement or GPP), public authorities can stimulate demand for green products and services and use their market leverage to encourage companies to invest in greener options. In this section we briefly illustrate ongoing research activities by researchers at the Universities of Naples (UNINA), Rome – Tor Vergata (UNITORV), and Padova (UNIPD).

The UNINA research group is dedicated to analyzing the role of public authorities in promoting Green Public Procurement (GPP) in Italy. Starting from the “Codice degli Appalti”, which describes basic procurement procedures in Italy in compliance with guidelines and criteria adopted by the European Commission, and from the recent set of minimum environmental criteria (CAM, or “Criteri Ambientali Minimi”) together with Italian legislation, the researchers study the current state of the art and the adoption of GPP at the national and European level. They also extend their analysis to regulations similar to CAMs adopted in other EU countries. These regulations helped to brainstorm a methodology for the selection of keywords identifying GPP tenders in a sample of calls for tenders. CAM objectives were identified at the sector level and school canteens were selected for analysis: information on school canteen tenders and related procurement contracts in different Italian regions and municipalities were collected and analyzed, with a file collecting GPP tender characteristics and identifying keywords. On this basis we presented a pioneering concept: an innovative indicator seeking to quantify the “degree of greenness” required by GPP calls.

The UNIPD research group aims to investigate the qualitative and quantitative elements in green procurement tenders and to assess their impact on the different phases of the procurement process (i.e. mainly the awarding and execution phases). Researchers are still in the process of collecting data for green procurement contracts in the various sectors. Once all the tender documents have been collected, researchers will apply automated techniques (currently being developed) using a variety of software (e.g. Python, R, Stata) and artificial intelligence to identify the greenness of a public procurement tender, and investigate the effectiveness of the award mechanism used – including the quality components of scoring rules in auctions – in terms of the awarding price and time and cost overruns. The researchers are also collecting information on the name and identity of the bureaucrats involved in the procurement process to assess whether their personal education, competence and ability play a role in the green procurement contracts awarded and carried out.

The UNITORV research group studies how the participation of small and medium-sized enterprises (SMEs) in public procurement processes is affected by the rules of green and sustainable procurement. Researchers also aim to investigate if public procurement promotes sustainable practices among SMEs. To this end, they examine the performance of SMEs in the Legality Rating. The Legality Rating (LR) is an institutional tool developed by the Italian Antitrust Authority to assess the legality of Italian companies in terms of fiscal transparency, the adoption of anti-corruption practices, the attention to corporate social responsibility, etc. By comparing the scores of companies meeting the minimum requirements, researchers can assess how companies may differ in their adoption of anti-corruption policies and sustainable standards.

2. Relationship with the existing literature on the topic

GPP has been only moderately investigated to date (i.e., UNEP, 2017; Chiappinelli and Zipperer, 2017). On the role of local public administrations (PAs), some studies highlight that PAs have experienced economic, political and cognitive difficulties with the implementation and maintenance of greener purchasing policies (Bouwer et al., 2006; Cheng et al., 2018; Testa et al., 2012). It is crucial for organizations to possess the requisite skills and tools since disparities between small and large municipalities can be mitigated through the provision of training programs and guidelines on GPP initiatives (Iraldo and Testa, 2007; Testa et al., 2012, 2016). Indeed, inadequate information concerning the real environmental impact of products, the challenges in finding suitable suppliers or in preparing green calls for tenders, the lack of guidance from higher-level authorities and collaboration between different authorities hinder the implementation of GPP (Testa et al., 2016). Similarly, the limited impact of green criteria on the final decisions in supplier selection (Igarashi et al., 2015) may be attributed to the authorities' deficiency in skills to integrate environmental criteria into the selection procedures (Cheng et al., 2018). Among the main challenges, limitations on financial resources have consistently been identified as a significant barrier to the broader implementation of GPP (Brammer and Walker, 2011; Preuss, 2007; Walker and Brammer, 2009; Warner and Ryall, 2001) due to the perception of increased expenses associated with green products compared to those that are not environmentally friendly. The common argument underlying the trade-off between environmental performance and purchasing price is that green technology raises marginal production costs. Suppliers incorporate this additional cost into their bids. In cases where the GPP mechanism prioritizes environmental quality over price, the procurer may, as a result, encounter

higher purchasing costs. In addition to the price premium paid by the administration, the potential environmental benefits of the procurement policy can, at least in part, be counterbalanced by the distorting costs of limited competition. However, Chiappinelli and Seres (2021) challenge the few existing theoretical studies (Lundberg and Marklund, 2011, 2013; Lundberg et al., 2016; Marron, 1997, 2003) that consider GPP an imperfect policy instrument, not cost-effective or objectively sound.

Regarding the role of GPP and firms, the economic literature on green and sustainable public procurement is still developing. In general, there are no specific studies investigating how and if green or sustainable public procurement affects SME participation in public procurement. A recent study by Marechal and Morand (2020), perhaps comes closest to our line of research. Therefore, it is important to understand whether social and environmental requirements can be used as a tool to increase favoritism. Social and environmental conditions are not used to alter participation in public procurement. Hoekman and Tas (2020) investigate the factors that may increase SME participation in public procurement in general. The authors suggest that increasing the quality of public procurement can increase the overall participation of SMEs. Iossa and Latour (2023) were the first to investigate the effects of the Legality Rating on public procurement. They find that a higher rating is associated with better performance in public procurement as measured by less time delays and costs.

3. Research output

The main research outputs of UNINA are summarized as follows:

1. identification of Italian keywords specific to GPP criteria in a particular sector (school canteens);
2. compilation of an Excel file containing detailed GPP tender specifications along with the corresponding keywords;
3. development of a composite indicator to assess the "degree of greenness" for these procurement calls.

Keywords were identified and taken from official EU documents pertaining to GPP implementation in each country. They vary significantly across sectors, with potential to expand this analysis to cover all sectors in the GPP directive. Focusing on the school canteen sample, the keywords predominantly relate to aspects of food quality and production locations. Consequently, UNINA developed a composite indicator to measure the "degree of greenness" (DG) by considering both the frequency of verifiable environmental keywords (as per institutional documents) and the weight of the technical proposal.

$$DG_{i,t} = \sum_{j,t} w_{i,j,t} X_{i,j,t}$$

The "degree of greenness" (DG) for each tender is computed by summing up the j characteristics considered in tender i at time t . In the equation, X represents the frequency of keywords, weighted by the proportion assigned to the technical proposal (w ranges from 0 to 1). Sector s should be included in the analysis when all GPP sectors are considered.

The research output of UNIPD is the following: in Italy, small neighboring municipalities can choose to merge into a single larger entity, and the central government provides financial incentives to municipalities willing to do so. Merging creates a discontinuity in the characteristics of the public buyer and its demographics and these can be used to study the adoption of GPP.

Information on all the tenders awarded by these municipalities was collected, and a large language model-based chatbot "ChatGPT" used to determine if the goal and implementation of the contract were environmentally friendly. As usual, for applications involving language models, significant time and effort were spent in developing the precise wording of the question put to ChatGPT. The information provided included the English translation of the textual description of the specific tender, as contained in the database of all Italian public procurement contracts managed by the Italian Anti-Corruption Agency.

As an example of the output provided by the language model, the following tender description is set out below: "WORK ON CONSOLIDATING SLOPES IN THE FONTANA DI CANEVINO AREA - FIFTH STAGE OF URGENT INTERVENTIONS IN RESPONSE TO THE WEATHER EVENTS OF NOVEMBER 2002"

The goal of the contract could be considered environmentally friendly as it involves the consolidation of slopes to prevent landslides or soil erosion, protecting the natural landform. Therefore, it scored 8.

The implementation is rather vague from the description provided. Therefore, with no specific environmentally friendly practices mentioned, it scores -1 (i.e., classification is not possible).

The main research outputs of UNITORV are summarized below.

To investigate how SMEs perform in the Legality Rating they employ two different sources of data. The first is the outcome of the Legality Rating at the firm level. The second refers to firm-level data retrieved from Aida Bureau van Dijk. In the final dataset, each firm is associated with a legality score, the date on which that score was assigned, the number of employees, revenues, share of females on the Board, average age of Board members, the municipality in which the firm is based and the sector in

which the firm operates. In addition, information on whether the firm is an innovative SME according to the Italian legal system is included. SMEs are identified in two different ways:

- A broad definition, including enterprises with on average – over the time span considered – under 50 employees and turnover of less than 10 million euros: SMEs (1). The share of enterprises of this kind is around 60% of the sample.
- A narrower definition, including enterprises that have on average under 25 employees and a turnover of less than 5 million euros: SMEs (2). The share of enterprises of this kind is around 30% of the sample. Since the aim is to run an initial explanatory analysis of the relationship between firm size and the legality rating, a standard Ordinary Least Square is employed to test for possible associations.

Table 1

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Legality Rating | Legality Rating | Legality Rating | Legality Rating | Legality Rating | Legality Rating |
| SMEs (1) | -0.334*** (0.011) | -0.335*** (0.011) | -0.323*** (0.012) | -0.323*** (0.011) | -0.306*** (0.012) | -0.305*** (0.012) |
| Women on the Board \geq 50 % | -0.045*** (0.014) | -0.045*** (0.014) | -0.035** (0.015) | -0.035** (0.015) | -0.018 (0.015) | -0.017 (0.015) |
| Age of Board members (log) | -0.174*** (0.030) | -0.174*** (0.030) | -0.137*** (0.033) | -0.137*** (0.034) | -0.039 (0.034) | -0.030 (0.035) |
| Observations | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 |
| R-squared | 0.106 | 0.106 | 0.264 | 0.264 | 0.432 | 0.469 |
| Mean Dep. Var. | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 |
| Year FE | | Yes | Yes | Yes | Yes | |
| Municipality FE | | | Yes | Yes | Yes | |
| Sector FE | | | | | Yes | Yes |
| Year x Municipality FE | | | | | | Yes |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.

The results below suggest that SMEs appear to have a lower score in the Legality Rating. Specifically, Table 1 suggests that SMEs is associated with a decrease in the Legality Rating by about 0.33, 17% of the mean.

With the second definition of SMEs, hence focusing on smaller enterprises, size still matters: SMEs have lower scores in the Legality Rating (see Table 2)

Table 2

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Legality Rating | Legality Rating | Legality Rating | Legality Rating | Legality Rating | Legality Rating |
| SMEs (2) | -0.266*** (0.010) | -0.267*** (0.010) | -0.258*** (0.011) | -0.258*** (0.011) | -0.247*** (0.011) | -0.241*** (0.012) |
| Women on the Board \geq 50 % | -0.059*** (0.014) | -0.059*** (0.014) | -0.047*** (0.015) | -0.047*** (0.015) | -0.033** (0.015) | -0.032** (0.016) |
| Age of Board members (log) | -0.201*** (0.030) | -0.201*** (0.030) | -0.165*** (0.034) | -0.165*** (0.035) | -0.056 (0.034) | -0.044 (0.036) |
| Observations | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 |
| R-squared | 0.067 | 0.067 | 0.233 | 0.233 | 0.413 | 0.451 |
| Mean Dep. Var. | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 |
| Year FE | | Yes | Yes | Yes | Yes | |
| Municipality FE | | | Yes | Yes | Yes | |
| Sector FE | | | | | Yes | Yes |
| Year x Municipality FE | | | | | | Yes |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3 shows the results when firm size and performance are used instead of any definition of SME. The first two variables are correlated with the legality rating. An increase in size, measured by the average number of employees and turnover, is associated with a higher Legality Rating.

Table 3

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------|----------------------|
| | Score | Score | Score | Score | Score | Score |
| Revenues (log) | 0.019*** (0.007) | 0.019*** (0.007) | 0.025*** (0.007) | 0.025*** (0.005) | 0.084*** (0.006) | 0.086*** (0.006) |
| Employees (log) | 0.133*** (0.006) | 0.133*** (0.006) | 0.123*** (0.006) | 0.123*** (0.005) | 0.069*** (0.006) | 0.066*** (0.007) |
| Women on the Board \geq 50 % | -0.043** * (0.013) | -0.043** * (0.013) | -0.031** (0.014) | -0.031** (0.015) | -0.003 (0.014) | -0.001 (0.015) |
| Age of Board members (log) | -0.250** * (0.029) | -0.250** * (0.029) | -0.222** * (0.033) | -0.222** * (0.034) | -0.124*** (0.033) | -0.120*** (0.034) |
| Observations | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 |
| R-squared | 0.154 | 0.155 | 0.306 | 0.306 | 0.466 | 0.502 |
| Mean Dep. Var. | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 |
| Year FE | | Yes | Yes | Yes | Yes | |
| Municipality FE | | | Yes | Yes | Yes | |
| Sector FE | | | | | Yes | Yes |
| Year x Municipality FE | | | | | | Yes |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

To further explore the association between SMEs and the Legality Rating, an additional test is provided to look at how being an innovative SME (around 2% of the sample) is associated with the Legality Rating. Table 4 shows the results, suggesting that the significant negative relationship between the Legality Rating and SMEs does not hold for innovative SMEs.

Table 4

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| | Score | Score | Score | Score | Score | Score |
| Innovative SMEs | 0.014 (0.033) | 0.015 (0.033) | -0.033 (0.038) | -0.033 (0.039) | -0.006 (0.039) | -0.007 (0.041) |
| Women on the board \geq 50 % | 0.079** * | 0.078** * | 0.064** * | 0.064** * | 0.054** * | 0.054** * |
| | (0.014) | (0.014) | (0.015) | (0.016) | (0.015) | (0.016) |
| Age of Board members (log) | 0.095** * | 0.095** * | -0.074* * | -0.074* * | 0.024 | 0.035 |
| | (0.031) | (0.031) | (0.035) | (0.036) | (0.035) | (0.037) |
| Observations | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 | 8,896 |
| R-squared | 0.004 | 0.004 | 0.183 | 0.183 | 0.375 | 0.417 |
| Mean Dep. Var. | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 | 1.928 |
| Year FE | | Yes | Yes | Yes | Yes | |
| Municipality FE | | | Yes | Yes | Yes | |
| Sector FE | | | | | Yes | Yes |
| Year x Municipality FE | | | | | | Yes |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Although the results are descriptive and should be treated with caution, the association can partly be explained by the fact that smaller firms are less able to meet the social and environmental standards now increasingly required in public procurement. This association is robust to different definitions of SMEs and withstands the inclusion of several controls such as the age of the Board of Directors, the proportion of women on the Board, municipality, year and sector fixed effects. This suggests fixed costs in complying with the standards or with the ability to properly document compliance (e.g. through certifications).

4. Policy implications

Modern, well-managed and efficient procurement is essential to ensure high quality public services. As major purchasers in various sectors (e.g. energy, transport, waste management, social protection, healthcare, education services), governments and other public entities can implement procurement practices for objectives that go beyond mere cost efficiency. Through strategic procurement, the public sector can actively contribute to increasing employment opportunities, stimulating economic growth and investment, and promoting a more innovative, environmentally sustainable, and socially inclusive economy.

In this context, data and the design of policies for a sharp reduction in carbon intensity are necessary and timely: the context in which the environmental/social/digital transition is taking place is becoming more and more complex due to increasingly unstable geopolitical conditions combined with rapid, unforeseen technological advances. The full involvement of actors – i.e. individuals and communities, companies, institutions – is crucial to achieving significant results in emissions reduction. In particular, it is essential to understand whether Italian public purchasers (e.g. city halls, state and central government agencies and ministries) take environmental sustainability into account when designing public procurement, and what the consequences of such decisions are in terms of environmental and economic outcomes.

Estimating green procurement features as well as company characteristics has several policy implications. First, the results of this research can help public purchasers in improving both efficiency and effectiveness in designing and awarding public tenders. Second, the output of this study can provide a better understanding of the features of participants and these in turn may be extremely relevant to understanding and predicting public tender performances. Specifically, the proposed results will continue to have an impact on the measurement of the levels of greenness, legality, and classification associated with GPP.

The level of greenness is a valuable tool for assessing the implementation of GPP and the potential environmental impact of a specific tender on its sector compared to others. This metric provides insights that can help policymakers and public officials to monitor the implementation of GPP in different institutions, both inside and between countries. By looking at the range of this indicator, it is also possible to identify the degree of heterogeneity across sectors. This in turn sheds light on which sectors have greater potential for a smoother and more effective 'green transformation'. Combined with other indicators related to the public budget allocated to the services analyzed, a

comprehensive analysis of the costs and benefits associated with greening these services within the institution is provided. The analysis is not only of practical importance, but also provides interesting theoretical insights to be explored in the next phase of our project. Focusing on the Italian context, it is particularly interesting to examine the status of GPP tenders in different regions and municipalities. This research analyzes potential spill-over effects and channels of cooperation between neighboring or related institutions.

Regarding the role of the Legality Rating and company characteristics, the research presented in the previous section suggests a strong association between company size and the rating. However, there is no such association for innovative SMEs. This difference has numerous policy implications. Innovative SMEs spend more on research and development and have better access to credit than standard SMEs. Perhaps innovative SMEs use the additional credit obtained to spend more on environmental or anti-corruption certification. Or perhaps innovative SMEs have more expertise, higher human capital (e.g. small biotech or engineering start-ups) or work on projects aimed at improving environmental issues and are therefore better able to comply with legal requirements. While there may be several drivers for innovative SMEs performing better in the Legality Rating, the first straightforward policy implication of our explorative analysis is that encouraging standard SMEs to become more 'innovative', for example by introducing larger tax exemptions for or to increase research and development, might help SMEs to close the gap with larger enterprises in terms of sustainable and green standards.

If one problem is the lack of human capital able to submit successful applications for higher ratings, then legal and technical support similar to the Small Business Administration bid support may be offered to SMEs by appropriate local offices. An additional or alternative way to avoid penalizing SMEs could be to develop a more flexible version of the current Legality Rating. If the Legality Rating can increase the chances of a company winning a public procurement contract, then SMEs may be penalized by its introduction because they do not meet the sustainability standards of larger companies. As mentioned above, SMEs may face more difficulties due to a lack of expertise in providing green and sustainable certification at the application stage. In such a scenario, policymakers could introduce a Legality Rating that takes into account the fundamental differences between SMEs and large companies, or allow to create two different Legality Ratings. Alternatively, Legality Ratings may be excluded as a possible award element in public tenders. If legally possible, tender preferences for SMEs could be introduced, to balance the effect of the Legality Rating and help SMEs to compete with large enterprises with better ratings, without penalizing the efforts/investments of innovative SMEs with high Legality Ratings.

Finally, the public availability of data for the analysis of the economic-financial system as a whole and its broadly understood sustainability (environmental, social, health, economic-financial) is crucial for future research, public awareness and data-driven

policymaking. In this context, existing public databases, such as the procurement data collected by the Italian Anti-Corruption Agency, can be integrated with artificial intelligence. Indeed, AI can be used to systematically exploit textual information otherwise difficult to include in statistical models. In the case of the GPP study, AI can be used to classify the degree of greenness of a public contract based on the brief description available in the general database. In addition, more granular and precise classification would be possible by accessing tender documents. These documents would also enable the study of the award mechanism in relation to greenness (i.e. the inclusion of green elements in the auction score) and not just the greenness of what the public authority purchases.

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