The GreenTransition and Competition in Public Procurement

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The green transition and competition in public procurement[*]

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Abstract

Over the last decade, the European legislation on public procurement has been clarified to facilitate "green" public procurement. Traditionally *best value for money* has been the main goal of public procurement, while new regulations has increased the scope for secondary goals such as environmental policy etc. We investigate how the secondary goal of greener public procurement has affected output of public tenders. Using the TED database, we investigate whether environmental criteria in public contracts are associated with a lower degree of competition. Exploring French public contracts between 2017 and 2020 for the 122 largest cities and metropolitan areas, our results show that the introduction of a green criterium in the public procurement notices negatively impacts the number of firms participating in the competitive tenders.

Keywords: Green public procurement, competition, contracts.
JEL classification: H4, H5, D73, K12

1   Introduction

Public procurement refers to the purchase by governments, local public authorities and state-owned enterprises of goods, services and works. In the European Union (EU), public procurement accounts for 14% of the GDP (and on average around 12% in OECD countries). As public

procurement accounts for a substantial portion of the taxpayers' money, governments are expected to carry it out efficiently and with high standards of conduct in order to ensure high quality of service delivery and safeguard the public interest.[1] This explains why "best value for money" has been the guiding principle of EU public procurement for a long time. However, over the past decades, this principle has been challenged in order to add various goals to public procurement, such a contributing to the green transition. Green public procurement (GPP) has become a widespead practice worldwide (Testa et al. (2012))[2]. In this paper, we investigate the impact of green public procurement on the efficiency of public procurement. More precisely, we analyze how the introduction of green criteria in public procurement has impacted efficiency through the degree of competition in calls for tenders.

Directive 2014/24/EU aimed at harmonizing the European legal framework of public procurement. In fact, Halonen (2021) argues that before the 2014 Directives it was not clear if contracts could be based on secondary objectives such as environmental concerns and the new directives therfore facilitated the introduction of green awarding criteria in public procurement notices (Pouikli (2021)). During a competitive tender to select an operator, public authorities can select one candidate among all the participants who respond to the call for tender based on not only propositions on prices, delays, technical specifications but also on environemental dimensions. While the use of green criteria represents an opportunity, it is not yet mandatory at the European level. It is worth noticing that several EU members countries push towards a more coercive vision on the use of green awarding criteria in public procurement. For instance, France plans to make such criteria compulsory by 2026. It is therfore cricual to better understand the impact of such criteria on public purchasing.

The introduction of green criteria in public procurement raises a lot of debate. Advocates of a greener public procurement recall that this strategy is a powerful way to respond to environmental challenges as it represents a large share of the GDP. In addition, if public buyers require some green behavior from their suppliers, this could contribute to the greening of the economy through two channels: by changing consumption patterns and by changing production patterns (Sapir et al. (2022)). Indeed, public purchasers may reduce their own polluting emissions, but also push industries to develop green technologies and products. However, this viewpoint is not unanimously admitted. As described in more detail below, some scholars ar-

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[1]See: https://www.oecd.org/gov/public-procurement/support/

[2]The European Union (EU) and its member states demonstrates commitment to GPP implementation (Tukker et al. (2008)). Similar ambitions are found in countries like the United States (Fischer (2010)) and China (Qiao et Wang. (2011), Wang et al. (2020)

gue that green public procurement could decrease the efficiency of public purchases. A first danger is that green contractual criteria may be a strategic tool leading to some kind of favoritism (Maréchal and Morand (2022)). Another concern is that green public procurement may increase the complexity of the procurement procedure. As stated by Sapir et al. (2022), "purchasers require knowledge and skills in order to green their procurement. In addition to mastering the legal framework, purchasers often need sufficient knowledge about the relevant goods or service market. They need to be able to calculate the total cost of ownership or the life-cycle cost, which requires specific tools. Thus, implementing green public procurement requires investment in training of the employees of contracting agencies". Last, adding a green criterium to select the operator is similar to an *additional constraint* that could reduce the number of bidders, and thereby the competitive pressure surrounding public procurement. This latter argument is in line with Djankov et al. (2002) who finds that stricter regulations on entrants (potential suppliers), tend to hurt rather than increase quality, and that regulation is both time consuming and costly for firms.

In this paper, we empirically assess whether environmental criteria are associated with lower competition in public purchases. We use TED (Tenders Electronic Daily) data on public procurement contracts registered by French public authorities in 2017, 2018 and 2019 from the FOPPA database (Potin et al. (2022)). TED is the online version of the supplement of the Official Journal of the European Union that is dedicated to the (compulsory) publication of the calls for tenders and award notices related to public procurement whose estimated cost is above the European thresholds. Focusing on the French case is particularly relevant: France has one of the highest levels of public procurement spending as percentage of GDP and is one of the countries using green criteria in public procurement the most. We consider two measures of environmental concern in public procurement: the extensive margin, i.e., whether there is an environmental criterium among the selection criteria or not, and the relative weight attributed to this environmental criterium among the other criteria. We study the number of firms that submit a bid to see whether it varies with the introduction of green criteria. Our results show that putting an environmental criterium in the selection procedure is associated with a lower number of bidders.

The remainder of the paper is organized as follows. Section 2 relates our paper to the previous literature. Section 3 describes the institutional framework while Section 4 describes the data used in the analysis. Our results are presented in Section 5. Section 6 briefly concludes.

2 Literature

Although the potential of green public procurement as an environmental policy is increasingly acknowledged in policy circles (Worldbank (2021), OECD (2023)), economic research on this topic is still limited (see literature reviews in Cheng (2018) and Chiappinell (2022)).

On the theoretical front, it has been argued that green public procurement is in general not cost-effective from a policy instrument perspective (Marron (1997), Marron (1997), Lundberg et al. (2016) and Lundberg and Marklund (2018)). These theoretical predictions have been empirically confirmed by Lundberg et al. (2016) and Drake et al. (2024) using data on the public procurement of internal cleaning services in Sweden. They find only a weak effect on supplier behavior, and, contrary to our findings, that it has limited impact on the participation decision and on the aggregate number of bidders. Furthermore and in line with theoretical predictions (Bizotto and Harstad (2023)), Simcoe and Toffel (2015) empirically show that green public procurement under the US Green Building Council's Leadership in Energy and Environmental Design has little, if any, influence on the private sector. Finally, Wang et al. (2020) find, based on Chinese procurement data, that green public procurement has a negative impact on price and time efficiency.

Lundberg and Marklund (2013) and Lundberg et al. (2015) suggest that for green public procurement to be effective as a policy instrument and have an impact is contingent upon the mandatory – binding – nature of the green criteria imposed on potential suppliers. To complicate the matter further, in a websurvey targeting civil servants in 290 municipalities in Sweden, Bryngemark et al. (2023) show that large municipalities often rely on GPP guidelines but may not adopt green criteria in tenders.

Based on the above-mentionned results about the effectiveness of green public procurement, Halonen (2021) takes a law and economics approach and suggest that, since the steering effect, costs and potential environmental impact of green public procurement vary in different industries, a sector-specific approach should be adopted in the development of green public procurement regulation.

Although not generally cost-effective, Lindström et al. (2020) and Lindström et al. (2023) show empirically that green public procurement can influence producers to invest in less polluting technology, e.g., organic farming.

The literature on the effect of green criteria on public procurement can be seen as part of a

broader literature which studies the effect of quality criteria on procurement outcomes. This literature argues that economic efficiency is expected to fall as adding quality aspects to a price competition makes the bidding and selection process more complex (Estache and Iimi (2012)), however government procurement costs may either increase or decrease depending on how the markets reponds to the introduction of quality criteria and the entry decision of firms (Marion (2007)). Focusing on electricty projects, Estache and Iimi (2012) empirically show that quality criteria raise prices and deters entry.

One quality aspect that has received considerable attention in the literature is bid preference programs. The aim of these programs is to facilitate participation of one type of disadvantaged bidder and thereby increase competition in the procurement. Such preferences are related to a quality aspect of competition and inclusion rather than quality dimension of the good or service to be procured. Myerson (1981), McAfee and McMillan (1989) and Maskin and Riley (2000) show in a theoretical framework that while bid preferences lower efficiency, they may also lower a government's procurement cost as they stimulate stronger competition. This part of the broad literature analyze the effect of existing preferential programs on procurement and competition, e.g., for domestic firms (McAfee and McMillan (1989)) and SMEs (Marion (2007), Krastnokutskaya and Seim (2011)) or other disadvantaged firms (Arve (2014),Marion (2009) Rosa (2020)). A recent contribution by Chiappinelli and Seres (2024) model a preferential program for green firms based on a bid discount and study the incentives to covert to green production technologies. They show that in this setting, green public procurement incentivizes investment from sufficiently low-cost firms in equilibrium and suggests that green public procurement is a relevant policy for a procurer who cares about minimizing the purchasing price while triggering green investment.

Our paper is related to Maréchal and Morand (2022). They show how a mechanism design approach can explain the factors that theoretically justify the use of environmental and social clauses in public procurement, potentially including favoritism and rent-seeking. Using French public procurement data for the year 2017, they empirically show that social and environmental clauses do not seem to be used as a tool for favoritism. We differ from this paper in several aspect. Our analysis covers a different and larger time period and, more importantly, we focus our analysis on the attractiveness of participating in public procurement and the effect of green public procurement on competition (as opposed to favoritism).

3   Institutional context

Public procurement refers to all contracts concluded by a public purchaser or a granting authority with a public service mission (contracting authorities or entities) to meet its needs for works, supplies or services, with one or more economic operators.

Public procurement law defines the procedures for drawing up, putting out for tender and executing these public contracts, in compliance with the principles of freedom of movement, equal treatment and transparency of procedures. The texts governing these different types of contracts derive in part from EU law: directive 2014/23/EU on concessions, 2014/24/EU on public procurement and 2014/25/EU on network activities. In France, all of the regulations related to public procurement are codified in the Public Procurement Code (Order No. 2018-1074 of November 26, 2018 and Decree No. 2018-1075 of December 3, 2018).

The core principles of EU public procurement are transparency, equal treatment, open competition, and sound procedural management[3]. Public buyers have to choose the *most economically advantageous offer*. However, this does not necessarily mean the cheapest offer in terms of price if other dimensions such as quality or green crieria are also included in the evaluation. In fact, in France, a procurement contract is awarded "on the basis of the most economically advantageous offer on the basis of one or more objective, precise criteria related to the subject matter of the contract or its performance conditions" (art. L2152-7 of the Code for public contracts, L3124-5 for concessions). Considerations relating to innovation, the environment, social issues, employment issues or the fight against discrimination may be introduced as performance conditions. However, for the time being, this choice remains at the discretion of the public purchaser.

An important change to French public procurement was introduced with the Climate and Resilience law of August 22, 2021. This law introduces a fourth major principle in French public procurement: the consideration of sustainable development objectives in their economic, social and environmental dimensions. It will require environmental considerations to be taken into account in the award criteria, in the conditions of performance (Article L2112-2 of the Code) and in the technical specifications. These provisions (for which a decree must be published) will come into force no later than 22 August 2026.

Such a trend aiming to promote green public procurement is not only observed in France,

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[3]https://single-market-economy.ec.europa.eu/single-market/public-procurement/legal-rules-and-implementation_en

but in many other European countries.[4] In a world, where green criteria become more and more prelevent (and soon compulsory), our analysis provides evidence of the effect of such regulation on competition in public procurement. To this aim, we ask the question of whether environmental criteria in public procurement are associated with a lower, higher or no change in the degree of competition.

The question of the impact of green criteria on the number of bidders is not an obvious one. Different scenarios could be considered. First, if the required green criteria are rather low or already widely practiced by the firms, then the introduction of such criteria may not change the number of bidders and competition remains unchanged.

However, the more demanding the green criteria become, the less likely it becomes for firms to meet them (without considerable investment) and this may lower the number of firms who chose to participate in the public tender. That is, some firms could be discouraged to bid, fearing their inability to meet these criteria. We could also think that some firms decide to no longer participate to public procurement, and focus on private markets only, where such criteria are not necessarily required.

Finally, other scenarios can also be imagined where the final impact of green criteria on the number of bidders is positive. For instance, we could also expect that more firms decide to switch to green technologies and production methods as they anticipate the increasing role of green criteria in public procurement. In this case, green criteria would not drastically change the number of bidders as firms would make some efforts to become *greener* so as to be able to continue to bid. Green criteria could also be interpreted as a signal of openness: anticipating that selection in public procurement will not only be driven by the price, this could motivate new firms to participate in public tenders and submit bids, thus increasing competition.

For all these reasons, the final impact of the introduction of green awarding criteria in public procurement is not straightforward, and empirical evidence is needed to better assess this impact.

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[4]For instance, the 2013 Berlin Procurement Law makes it compulsory for public procurers to formulate environmental criteria for tenders of construction valued over EUR 50 000. Transposing European Directive 2014/23/UE and Directive 2014/24/UE, Spanish Law 9/2017, of 8 November, on public sector contracts (Law 9/2017) states that "environmental criteria will be incorporated in a transversal and mandatory manner, provided that it is related to the object of the contract, in the conviction that their inclusion provides a better value for money in the contractual provision". Estonia established in 2022 four product groups in which green criteria is compulsory. Meanwhile, the Polish State Purchasing Policy 2022–2025 foresees the development of a catalogue of products and services for which green criteria is compulsory (Kaaret K. et al. (2022)). In Norway, since January 1st, 2024, green criteria shall be used as an award criterion with a weight of at least 30% in public procurement.

4 Data

We use the FOPPA database where public procurement award notices registered by French public authorities are collected (Potin et al. (2022)). These award notices were collected from the European database TED (Tenders Electronic Daily), the online publication outlet of the Official Journal of the European Union (OJEU). Beyond certain thresholds[5], all calls for tenders and award notices related to public procurement have to be published on the OJEU.

Our analysis focuses on the 100 largest cities in France (based on their 2018 population), as well as the 22 French "metropoles", i.e. the 22 largest local communities (i.e. a large city with smaller municipalities around it).[6] Figure 4 shows the location of the 100 largest French cities and the 22 Metropoles.
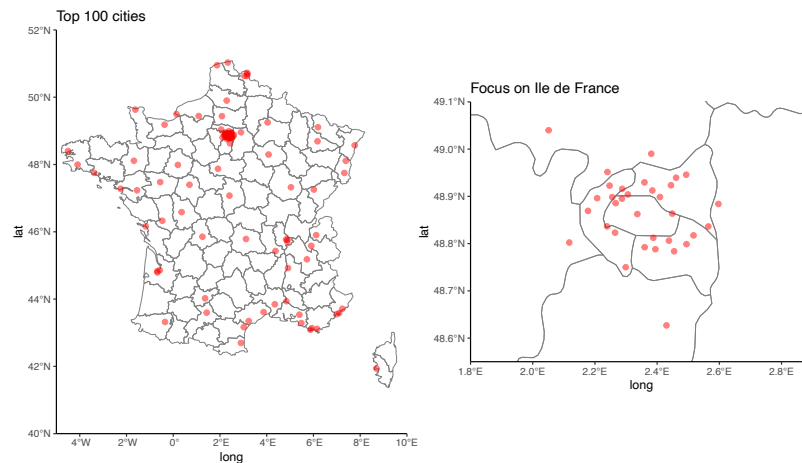

Figure 1: Top 100 cities and metropoles

[5]The tresholds depend on the value of the market, the nature of the goods or service to provide, and the identity of the public purchasers. Details about the european threshold can be found here: https://single-market-economy.ec.europa.eu/single-market/public-procurement/legal-rules-and-implementation/thresholds_en

[6]Metropoles were created by the law of December 16, 2010. According to article L5217-1 of the French General Code of Territorial Collectivities, a metropole is a public establishment for inter-communal cooperation that groups together several "contiguous and enclave-free" municipalities, which join together within "a space of solidarity to draw up and lead together a project for the economic, ecological, educational, cultural and social planning and development of their territory, in order to improve its competitiveness and cohesion". The metropoles aim to enhance metropolitan economic functions and transport networks, and to develop university, research and innovation resources. Established on a voluntary basis, the status of metropole is open to groups of over 400,000 inhabitants in an urban area of over 650,000. Municipalities transfer to the metropole several public services, as water management, garbage collection, or public transporation. Source: https://www.gouvernement.fr/action/les-metropoles

Our observations are at the contract level for the years 2017, 2018 and 2019.[7] We select contracts for which only one buyer was identified.[8] To avoid outliers, we also drop contracts where the number of tenders was strictly higher than 20 (less than 3% of our observations). Public buyers have to publish contracts above the European tresholds on TED, but they can also publish contracts above these tresholds. Because public buyers have different practices regarding publication of contracts below the European tresholds, and to avoid selection effects, we focus our analysis on contracts above the European tresholds for which public buyers have to publish information.[9]

This leads us to a database made up 115 public buyers[10] and 6133 contracts.

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[7]We focus on the period 2017-2019 since green criteria where only introduced in 2016. We also limit our sample to the pre-pandemic period to avoid issues specific to that period.

[8]This allows us to control for the characteristics of the city of the buyer.

[9]In practice, we drop contracts whose award price or award estimated price were below 209,000 euros for utilities or services and 5,225,000 euros for works for the year 2017. We proceed in a similar way with thresholds 221,000 and 5,548,000 euros in 2018 and 2019.). We also keep observations with information coming both from contract notives and contract award notices (95% of the observations) so as to have information on the number of tenders for each contract.

[10]More precisely, we have 93 cities and 22 metropoles. Even if we targeted 100 cities, some of them do not appear in our database: they may have no contract Above the European tresholds over the three years under study.

To measure environmental criteria we use two different variables in order to capture two dimensions of environmental criteria. First we consider a dummy variable which takes the value one if the public tender specifies (at least) one environmental criterium. This variable, which is named *environment,* captures the extensive margin of environmental criteria. The second variable, *weightenv,* aims to capture the intensive margin of environmental criteria and gives the (relative) weight that is given to environmental criteria in the selection process.

Our database contains a total of 6,133 contracts, and around 13,9% of these have at least one environmental criterium as shown in table 1.

	2017	**2018**	**2019**	Total
Number of contracts with:				
- No environmental criterium	1,541	1,816	1,922	5,279
- One (at least) environmental criterium	330	241	283	854
Total	1,871	2,057	2,205	6,133

Table 1: Number of contracts and environmental criteria

To assess the impacts on competition, we look at the number of offers received by the public authority following the call for tenders (variable *tenders*).[11] Figure 4 describes the average number of offers received: we observe that the average number of bidders is 4,08 when contracts do not have any green criteria, while 3,55 tenders are observed on average when the contract has one environmental criterium.[12] A standard t-test indicates that the difference between the average of the two groups is statistically significant.

Table 4 and table 4 summarize all variables used in our analysis. Data related to municipal and metropole characteristics are collected from the French National Institute of Statistics and Economic Studies (INSEE).

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[11]Many papers in the literature have shown that a high numbers of bidders during a competitive tendering for public procurement leads to lower procurement cost (Onur et al. (2012), Amaral (2013)).

[12]Among the 854 contracts with an environmental criterium, only 6 (included among the 854) have more than one environmental criterium: 4 contracts have two and 2 contracts have three.
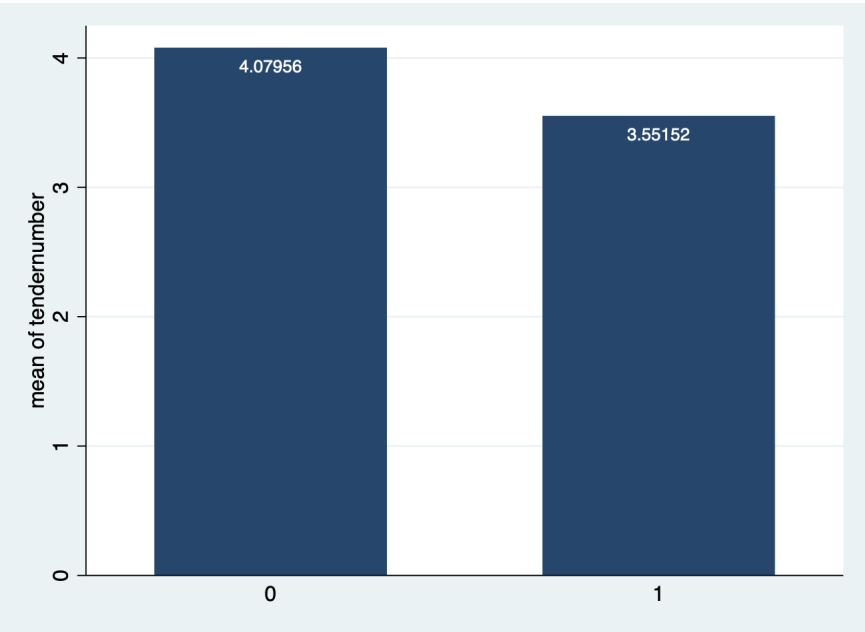
Figure 2: Number of tenders according to environmental criteria

Variable	Meaning	N	Mean	St.D.
Contract				
Environment	=1 if an environmental criterium appears in the selection criteria, 0 else	6,355	0,138	0,34
Weightenvmaw	the maximal weight allocated to the environmental criterium in the contract	879	11,86	7,91
Tendernumber	Number of tenders received for the contract	6,355	4,01	3,07
Utility	=1 if the contract is about the provision of goods	6,355	0,33	0,47
Work	=1 if the contract is about works	6,355	0,05	0,23
Service	=1 if the contract is about services	6,355	0,62	0,48
Price	=1 if the contract has at least one price criterium	6,335	0,93	0,26
Technical	=1 if the contract has at least one technical criterium	6,335	0,81	0,38
Delay	=1 if the contract has at least one criterium about delay	6,335	0,11	0,31
Social	=1 if the contract has at least one social criterium	6,335	0,03	0,168
Other	=1 if the contract has at least one criterium classified as "other"	6,335	0,18	0,38
Contract duration	The average duration of the contract (months)	5,466	29,5	21,4
Publicity duration	The average duration of the advertising time (days)	5,681	39,4	10,4
Subcontract	=1 if there is subcontracting, 0 else	6,351	0,14	0,35
Renew	=1 if the contract is renewed, 0 else	5,673	0,69	0,46
Open	=1 if the selection procedure is open	6,355	0,914	0,28
Restricted	=1 if the selection procedure is restricted	6,355	0,012	0,11
Cod	=1 if the selection procedure is a competitive dialogue	6,355	0,005	0,07
Nego	=1 if the selection procedure is a competitive procedure with negotiation	6,355	0,05	0,22
AwardPrice	The contract award price	6,316	4.92e+07	1.29e+09
AwardEstimatedPrice	The estimated price by the public authority	972	2341227	7477011
SMEwinner	Takes value 1 if the winner of the bid is a SME	6,321	0.45	0.49
Localism	Takes value 1 if the supplier and the client are from the same county	5,438	0,45	0,49

Table 2: Descriptive statistics - Contracts

Variable	Meaning	N	Mean	St.D.
City				
Population	Population in the city/metropole (on year t)	6,355	756319	895435.7
Population64	People above 64 years old (on year t)	6,355	129206	149668
Unemployed1564	Rate of Unemployment(on year t)	6,355	0,14	0,035
Actifs1564_2018	Labor force 15-64 (on year t)	6,355	34117.6	462771.5
Revmedian	Median income (on year t, in euros)	5,438	23350	5273
Metropole	Takes value=1 if the public procurer is a metropole	6,355	0.62	0.48
Municip	Takes value=1 if the public procurer is a municipality	6,355	0.62	0.48
Left	Takes value=1 if there is left-wing Mayor (for municipality) or a left-wing President (for metropoles)	6,355	0,47	0,49
Right	Takes value=1 if there is right-wing Mayor (for municipality) or a right-wing President (for metropoles)	6,355	0,46	0,49
Center	Takes value=1 if there is Mayor (for municipality) from the center or a President (for metropoles) from the center	6,355	0,003	0,061
Green	Takes value=1 if there is Mayor (for municipality) from the Green Party or a President (for metropoles) from the Green Party	6,355	0,005	0,073
Farleft	Takes value=1 if there is far left-wing Mayor (for municipality) or a far left-wing President (for metropoles)	6,355	0,013	0,11
Farright	Takes value=1 if there is far right-wing Mayor (for municipality) or a far right-wing President (for metropoles)	6,355	0,003	0,056
Nopol	Takes value=1 if the Mayor (for municipality) has no political affiliation or a President (for metropoles) has no political affiliation	6,355	0,03	0,18

Table 3: Descriptive statistics - Cities

5 Empirical analysis

To determine the impact of environmental criteria on the number of bidders, we rely on Poisson estimations[13]. We test the two following formulations:

$$y_{c,t,m} = \alpha + \beta Environment_c + \gamma X_{c,t,m} + \gamma' X_{m,t} + z_t + \delta_m + \epsilon_{c,t,m} \tag{1}$$

$$y_{c,t,m} = \alpha + \beta weightenv_{c,t,m} + \mu weightenv^2_{c,t,m} + \gamma X_{c,t,m} + \gamma' X_{m,t} + z_t + \delta_m + \epsilon_{c,t,m} \tag{2}$$

The first equation aims at evaluating whether putting an environmental clause in a contract is correlated with competition. The key parameter of interest is β which provides an estimate of the effect of an environmental clause on the competition indicator. We introduce several controls: $X_{c,t,m}$ represents the variables related to the characteristics of the contract c of municipality m at year t (selection, procedure, subcontract, nature of the contract (works, services compared to goods), ...), $X_{m,t}$ are controls related to municipalities at year t (size, political color of the mayor, average revenue,...), z_t is a year fixed effect and δ_m a municipality fixed effect to capture unobserved time-constant effects of each municipality.

While equation (1) focus on the extensive margin (having a green clause or not), equation (2) investigates the intensive margin by exploring whether the weight of the environmental clause is correlated to the competition indicator. We allow for non-linearity by introducing the variable $weightenv^2_c$.

The variable $y_{c,t,m}$ represents the number of tenders for contract c signed by municipality j on year t.

5.1 Main Estimations

Table 4 shows the main results of the Poisson estimations. Control variables on contracts include the category (whether the contract is about service, utility or works), contract duration,

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[13]Poisson regression is a count regression model. Coefficients are exponentiated, since counts must be 0 or greater. Poisson regression assumes a Poisson distribution, often characterized by a substantial positive skew (with most cases falling at the low end of the dependent variable's distribution) and a variance that equals the mean. Because count data distributions (e.g., visit counts) often have a Poisson distribution, Poisson regression tends to fit these data better than linear regression, which assumes a normal distribution, does (Elhai et al. (2008)). For this reason, we keep Poisson estimations in our main analysis, but still provide standard OLS regressions of our main results (Table 4) in the appendix.

publicity duration, whether the contract includes sub-contracting, whether the contract is renewed, whether GPA (Agreement on Government Procurement) applies, whether it is a framework agreement, and the type of selection procedure (open auctions, restricted auctions, negotiation, competitive dialogue). Controls at the public authority level include whether the public authority is a municipality or a metropole, the median income of inhabitants, the unemployment rate, the number of inhabitants, of labour force, and of population above 64 years old.

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	-0.142***	-0.116***	-0.124***	-0.133***
	(0.0237)	(0.0282)	(0.0285)	(0.0345)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.420***	0.157	0.132	5.562**
	(0.0183)	(0.157)	(0.211)	(2.742)
Observations	6,133	5,251	5,251	5,251

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

Table 4: Poisson estimations

The results in Table 4 show that in our data, tenders which include environmental criteria are associated with a lower number of bidders. These results are significant at the 1% level. Calculating the marginal effect of "environment" on the number of tenders, we find a value of -0.547. This indicates that, on average, introducing an environmental criterium is associated with a decrease of 0.54 candidates submitting a proposal. This effect is statistically significant at the 1% level (p = 0.00). As there are four tenders on average, this suggests that introducing an environmental criterium represents a decrease of 13,6% of the number of tenders.

In the appendix, we run additional estimations similar to those in Table 4, but we separate our

sample between contracts relative to works, services and utilities. Results show that the negative impact of green criteria on the number of bidders come from service and work contracts (that represents 66% of our observations). The introduction of a green criterium in utility contracts is not associated with a lower number of tenders. This may comes from a higher difficulty to meet green standards in services and works, compared to goods whose production is maybe more regulated by environmental standards.

5.2   Robustness checks

To check whether other criteria than environmental criteria, such as price and quality criteria, also affect competition, we run new estimations where we include additional controls (whether the contract also includes criteria on price, delay, technics or other criteria). Table 5 shows the results of these regressions and the results are similar to those in table 4. Interestingly, the other criteria have no impact on the number of tenders, with the exception of criteria on delays. This may suggest either that the relatively novelty of green criteria compared to other more standard criteria as price or technical requirements makes it more costly to submit a bid thus reducing participation or that some firms drop out because of public tenders with green criteria as they are no longer attractive for firms that are not "green enough". Social criteria are also new but quite infrequent in our database (3,4% of the contracts), which may explain the absence of significant effect. Criteria on delays act as a constraint on bidders that can hardly be changed easily: this explains why they also impact negatively the number of tenders. Criteria on price also have a significant and negative impact on the number of tenders (with the exception of column 4). This may suggest that price criteria act as a signal of an intensive competition and may deter some companies to participate and bid in public procurement.

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| | (1) | (2) | (3) | (4) |
VARIABLES	tendernumber	tendernumber	tendernumber	tendernumber
environment	-0.129***	-0.114***	-0.127***	-0.132***
	(0.0236)	(0.0285)	(0.0287)	(0.0341)
price	-0.229***	-0.258***	-0.237***	-0.274
	(0.0370)	(0.0361)	(0.0404)	(0.215)
delay	-0.206***	-0.0983***	-0.105***	-0.133**
	(0.0307)	(0.0342)	(0.0345)	(0.0598)
technical	0.0391	0.00295	0.0156	-0.0426
	(0.0271)	(0.0280)	(0.0280)	(0.0495)
social	0.0829	0.0407	0.0316	0.0104
	(0.0553)	(0.0576)	(0.0579)	(0.119)
other	0.0604**	0.0197	0.00255	-0.0531
	(0.0267)	(0.0285)	(0.0287)	(0.0487)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.611***	0.367**	0.501*	98.20***
	(0.0464)	(0.164)	(0.260)	(36.82)
Observations	6,133	5,251	5,251	5,251

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

Table 5: Poisson estimations with criteria controls

Related to the analysis above, one might also think that the number of criteria itself may influence competition. More criteria makes the tender process more complex and thereby more costly for the firms, implying that the number of submitted offers in a tender could decrease witht the number of criteria imposed in the tender. We therefore run estimations to see whether the number of criteria matter: the variable "countcriteria" counts the number of other criteria (whether related to price, delay, technical requirements, etc.) and acts a control in estimations run in table 6. Our results still hold.

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	-0.137***	-0.109***	-0.119***	-0.130***
	(0.0238)	(0.0285)	(0.0287)	(0.0347)
countcriteria	-0.0155	-0.0245**	-0.0208*	-0.0397
	(0.00961)	(0.0106)	(0.0107)	(0.0368)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.456***	0.218	0.221	93.12***
	(0.0275)	(0.159)	(0.254)	(30.73)
Observations	6,133	5,251	5,251	5,251

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

Table 6: Poisson estimations with criteria controls

5.3 Intensive margins

The results in the analysis above is limited to the effect of green criteria on the extensive margin. We now turn to analyse the effect on the intensive margin. To do so, we consider the weight allocated to the green criterium (from 0 to 100%) in the evaluation of the offers. The results in Table 7 show that there is a non-linear effect that could be interpreted as follows: small values

of green criteria encourage competition and is associated with a higher number of bidders, but higher weights on the green criterium decreases competition and discourage bidders. This can be interpreted as a "signal" effect of green criteria: the competition could be less hard on prices when environmental aspects are considered, but for high values of green considerations, fewer bidders could be eligible to submit competitive offers. Note however, that city fixed effects in the last column in Table 7 removed this effect. The relatively small sample size may affect our results and these results should be interpreted with caution.

	(1)	(2)	(3)	(4)
VARIABLES	tendernumber	tendernumber	tendernumber	tendernumber
weightenvmax	0.0186***	0.0188**	0.0201**	0.00832
	(0.00708)	(0.00852)	(0.00844)	(0.0104)
weightenvmax2	-0.000248**	-0.000262*	-0.000288**	-0.000130
	(0.000121)	(0.000149)	(0.000145)	(0.000146)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.181***	0.493***	0.547	2.404
	(0.0731)	(0.150)	(0.378)	(9.101)
Observations	854	682	682	682

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

Table 7: Poisson estimations of green weight

5.4   Other impacts of the environmental critera

Finally, we investigate whether green criteria are associated with other awarding practices. To reach this goal, and in line with Maréchal and Morand (2022) we first investigate the question of local providers and analyse whether green crieria in public procurement is associated with buying more or less *local*, i.e., local suppliers being awarded contracts. This tells us something about for whom (green) public procurement is attractive. To do so, we add information on the supplier to the previous dataset.[14] This allows to determine the variable *localism* that takes the value 1 if the supplier (the firm winning the bid) and the client (the public authority) are from the same municipality. Results are shown in Table 8. When only year fixed effect or contract controls are included, our results suggests that environmental criteria in the tender is associated with less local suppliers being awarded the contract. This would suggest that there might be larger (regional or national) firms that are more invested in green provision of their goods or services. However, when adding city controls and fixed effects, this result disappears, suggesting that at an aggregate level such a theory is not supported by our data.

VARIABLES	(1) localism	(2) localism l	(3) localism	(4) localism
environment	-0.205***	-0.169***	-0.0792	0.0391
	(0.0482)	(0.0549)	(0.0537)	(0.0571)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	-0.751***	-2.093**	-1.426*	-10.63**
	(0.0284)	(0.857)	(0.789)	(4.277)
Observations	5,247	4,462	4,462	4,462

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

Table 8: Poisson estimations of buying local

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[14]We keep observations for which only one provider is identified.

We also investigate whether green criteria are associated with more SMEs being awarded the contract. Table 9 shows that that contracts are not awarded more often to SMEs when there is at least one green criteria. This suggests that green criteria are not more attractive for local and SMEs providers, or that public buyers do not manipulate green criteria to award more locally or more to SMEs their contracts.

VARIABLES	(1) sme_winner	(2) sme_winner	(3) sme_winner	(4) sme_winner
environment	-0.0511	0.00958	-0.0223	-0.0765
	(0.0426)	(0.104)	(0.101)	(0.0783)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	-0.726***	-0.567**	-1.048*	-9.593**
	(0.0251)	(0.232)	(0.601)	(4.257)
Observations	6,099	825	825	5,248

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

Table 9: Poisson estimations - SMEs are awarded the contract

6 Conclusion

In this paper we have studied the effect of environmental criteria on the number of bidders in public procurement. Our results sheds light on the use of public procurement to reach general policy goals related to the green transition. A core concern related to such a policy is whether adding green criteria in the awarding procedure comes at the expense of the competition for public contracts. Our results show that the introduction of green criteria in public procurement is associated with a lower degree of competition, as fewer bidders submit a proposal.

The use of green criteria in public procurement in France is still voluntary, but will become

compulsory from 2026. Many other countries follow the same path. Our results therefore provides policy makers with important information about potentially undesirable side-effects of such a policy. However, the effect identified could be of a short-run and transitory nature. Future research will have to confirm what the effect would be in the long run. Such research would also be able to analyse the effect of a compulsory change in regulation.

A   Appendix

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	-0.540***	-0.422***	-0.457***	-0.540***
	(0.0870)	(0.101)	(0.103)	(0.126)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	4.136***	0.468	0.257	21.17*
	(0.0745)	(0.328)	(0.668)	(12.34)
Observations	6,133	5,251	5,251	5,251
R-squared	0.005	0.059	0.066	0.114

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

Table A.1: OLS estimations

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	-0.190***	-0.156***	-0.188***	-0.219***
	(0.0405)	(0.0441)	(0.0452)	(0.0411)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.471***	0.266	0.631**	5.013
	(0.0241)	(0.181)	(0.270)	(3.431)
Observations	3,721	3,222	3,222	3,222

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

Table A.2: Poisson estimations - Service contracts

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	0.0288	-0.0277	-0.0169	0.0282
	(0.0304)	(0.0339)	(0.0336)	(0.0531)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.269***	0.235	0.0635	5.892
	(0.0303)	(0.235)	(0.321)	(5.537)
Observations	2,077	1,738	1,738	1,738

Robust standard errors in parentheses

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

Table A.3: Poisson estimations - Utility Contracts

VARIABLES	(1) tendernumber	(2) tendernumber	(3) tendernumber	(4) tendernumber
environment	-0.105	0.0477	0.0808	0.198*
	(0.0718)	(0.0791)	(0.0870)	(0.105)
Controls Contract		X	X	X
Controls City			X	X
Year FE	X	X	X	X
City FE				X
Constant	1.498***	1.362***	0.213	-20.56**
	(0.0485)	(0.122)	(0.788)	(9.839)
Observations	335	291	291	291

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

Table A.4: Poisson estimations - Work Contracts

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Over the last decade, the European legislation on public procurement has been clarified to facilitate "green" public procurement. Traditionally *best value for money* has been the main goal of public procurement, while new regulations have increased the scope for secondary goals such as environmental policy etc. We investigate how the secondary goal of greener public procurement has affected output of public tenders. Using the TED database, we investigate whether environmental criteria in public contracts are associated with a lower degree of competition. Exploring French public contracts between 2017 and 2020 for the 122 largest cities and metropolitan areas, our results show that the introduction of a green criterium in the public procurement notices negatively impacts the number of firms participating in the competitive tenders.

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