THE IMPACT OF GOVERNMENT GREEN PROCUREMENT ON CORPORATE ENVIRONMENTAL PERFORMANCE

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(Received 25th Apr 2025; accepted 16th Jun 2025)

Abstract. With the increasing severity of global environmental challenges, government green procurement (GGP), as an effective demand-side environmental governance tool, requires a clearer understanding of its impact mechanism on corporate environmental performance (CEP). Utilizing data from China's A-share listed companies (i.e., companies listed on the Shanghai and Shenzhen Stock Exchanges in mainland China), this study adopts a staggered difference-in-differences approach to comprehensively analyze the effects of GGP on CEP, along with the underlying mechanisms driving these impacts. Our study reveals that GGP significantly enhances CEP. A mechanism analysis reveals that GGP enhances CEP through the improvement of executive green awareness, the promotion of green innovation, and the encouragement of greater investment in environmental protection. A heterogeneity analysis shows that the positive effect of GGP on CEP is more pronounced in non-state-owned enterprises and industries characterized by high market competition. This study significantly contributes to the literature on the environmental impacts of government procurement and offers actionable insights for policymakers to refine GGP policies, thereby accelerating the green transformation of enterprises.
Keywords: *government green procurement, corporate environmental performance, green innovation, executive green cognition, environmental protection investment*

Introduction

The swift pace of global economic growth has brought to the forefront the issue of environmental pollution, a challenge of global proportions that can no longer be ignored (Yuan and Cao, 2022; Huo and Peng, 2023). This issue imperils not just human health and welfare but also the very fabric of biodiversity and the sustainability of ecosystems (Pörtner et al., 2023). Currently, there is a widespread agreement among countries on the necessity of balancing economic progress with environmental conservation, steering towards a trajectory of green and sustainable development (Karlilar et al., 2023; Musah et al., 2024; Nguyen et al., 2025). In the case of China, the remarkable economic milestones achieved since the 1978 reforms and the establishment of a robust industrial system have come at the cost of substantial natural resource and energy consumption (Cheng and Xu, 2023; Liu et al., 2024), resulting in environmental pollution that continues to be a pressing concern for the authorities (Wan et al., 2023). In recent years, the Chinese government has demonstrated exceptional commitment to environmental conservation, with green development principles deeply integrated into national strategic plans and proactive efforts

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2304_75937617

toward green economic transition and sustainable development (Shan and Shao, 2024; Wan and Su, 2024).

Policymakers and researchers unanimously recognize that corporations, as principal actors in the market economy, are among the major sources of resource depletion and environmental pollution (Du and Li, 2021; Du et al., 2022). As such, the role of corporations in environmental stewardship is paramount, necessitating their assumption of environmental responsibilities through the implementation of technological advancements and managerial enhancements to lessen their detrimental environmental footprint (Lu et al., 2022; Zhang and Zhu, 2024). In this context, China has implemented a range of environmental oversight policies, including an environmental tax (Fang et al., 2023; Liu, 2024), green credit policies (Lai et al., 2024; Guo et al., 2024a), and the environmental protection inspector system (Zhong et al., 2023; Zhao et al., 2024). These measures aim to curb pollution emissions from the supply side and encourage enterprises to adopt green production practices.

However, for environmental governance and pollution reduction, in addition to supply-side constraints, demand-side incentives are equally crucial (Zhang and Zhu, 2024). Government procurement, recognized as a crucial demand-side policy instrument (Edler and Georghiou, 2007), is anticipated to stimulate the adoption of green development philosophies among enterprises and to foster green innovation through market-oriented mechanisms, consequently enhancing corporate environmental performance. International experiences indicate that government procurement policies, by offering market incentives, have become a key instrument in steering businesses towards green and low-carbon development paths, thereby advancing sustainable development on a global scale (Lindström et al., 2020; Krieger and Zipperer, 2022).

Government green procurement (GGP) involves the approach where government agencies, when allocating financial resources for purchasing, give preference to or mandatorily choose products and services that exert minimal adverse effects on the environment, adhere to national environmental regulations, and support the advancement of a circular economy (Kou et al., 2024). As outlined in the 2003 "Government Procurement Law of the People's Republic of China," the aim of government procurement is to advance the nation's economic and social goals, placing significant emphasis on environmental sustainability. Much of the existing literature has examined the role of government procurement in promoting green innovation, highlighting its importance as a key demand-side policy mechanism for encouraging businesses to develop environmentally friendly technologies (Krieger and Zipperer, 2022; Kou et al., 2024; Liu et al., 2024). This impact can be elucidated through two primary dimensions: Firstly, the substantial and consistent demand generated by government procurement provides enterprises with stable cash flows, thereby mitigating uncertainties associated with green innovation endeavors (Liao et al., 2024). Secondly, government procurement underscores the paramount importance of stringent green production standards and products, compelling enterprises to continually enhance their green product manufacturing and service quality to secure ongoing green procurement contracts (Cheng et al., 2024).

However, despite growing attention to the impact of GGP on corporate green innovation, empirical evidence regarding its influence on CEP remains scarce or has been overlooked. While green innovation serves as a critical driver for enhancing enterprises' pollution control capabilities, further research should investigate whether GGP can facilitate comprehensive improvements in corporate environmental governance. Consequently, within the ambit of Sustainable Development Goals (SDGs) 10 and 16, and

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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against the backdrop of government procurement's evolving role as an environmental governance instrument, there is an exigent need for additional theoretical and empirical analyses on the effects of GGP on CEP. This research endeavors to address this void by exploring the responses of enterprises to GGP.

We employed data from China's A-share listed companies from 2015 to 2022 to examine the causal link and underlying mechanisms between GGP and CEP. This research adds to the existing body of knowledge in several significant aspects:

First, our study significantly contributes to the understanding of the drivers of CEP. Prior research has primarily focused on identifying the factors influencing CEP through institutional design (Tang et al., 2024; Yang et al., 2024), cultural aspects (Wei and Peng, 2025), stakeholder dynamics (Ming et al., 2023; Chen et al., 2024a; Zhou et al., 2024), and executive characteristics (Kim, 2024; Velte, 2024). However, these studies have largely overlooked the impact of government demand shocks on CEP through transmission mechanisms. By linking government green procurement (GGP) to CEP, our research aims to enrich the existing literature and provide a more comprehensive understanding of the factors that drive CEP.

Second, this research extends the discourse on the environmental implications of government procurement. Historically, the literature has concentrated on the economic impacts of government procurement, revealing its positive and significant role in fostering rural entrepreneurship (Guo et al., 2024a), enhancing urban innovation quality (Mao and Zhong, 2024), and improving corporate investment efficiency (Cohen and Li, 2020). While a subset of studies has examined the incentive effect of GGP on green innovation, it remains unclear whether GGP can further enhance the environmental performance of enterprises. Additionally, there is insufficient understanding of the underlying mechanisms through which government procurement generates environmental effects. This paper aims to systematically investigate how GGP improves CEP and analyze the differentiated policy impacts under varying corporate and industry characteristics. Consequently, our study contributes academically to the expansion and enrichment of research pertaining to the environmental effects of government procurement.

Our study's third marginal contribution is reflected in the innovation of data and methodological approaches. We utilized Python to scrape government procurement contracts from the Chinese government procurement website, constructed a green procurement lexicon based on the GGP list, and employed text analysis techniques to determine whether listed companies and their subsidiaries had obtained green procurement contracts. Subsequently, we merged this data with panel data of listed companies to create a dataset related to government green procurement at the corporate level. This dataset is characterized by its high reliability and significant research value. In terms of research methods, we differentiate firms that have successively obtained GGP orders from other firms and employ DID model for empirical analysis. This approach is more conducive to identifying the effects and mechanisms of exogenous GGP impacts on CEP, thereby enhancing the credibility of our research conclusions.

The rest of this paper is structured as follows: In Section 2, we review the pertinent literature and formulate research hypotheses based on theoretical analysis. Section 3 describes the research methodology and the process for sample selection. Section 4 provides an analysis of the empirical results. Section 5 explores the pathways by which GGP impacts CEP. Section 6 investigates the influence of heterogeneity. Lastly, Section 7 and Section 8 offer a summary of the main findings and discusses their policy implications.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Literature review and hypothesis development

Literature review

Influencing factors of corporate environmental performance

Corporate environmental performance (CEP) denotes the aggregate manifestation of a firm's impact on the natural environment through its production and business operations. It includes endeavors and achievements in mitigating environmental pollution, enhancing resource utilization efficiency, advancing ecological balance, and supporting sustainable development (Dragomir, 2018; Jin et al., 2023; Shao et al., 2024). Scholarly exploration of the determinants of CEP can be primarily divided into external and internal factors (Tang et al., 2024). In terms of external factors, empirical evidence has established that governmental environmental regulatory pressures exert a substantial influence on CEP. For example, Pan et al. (2024) examine the central government's oversight of local environmental enforcement using a quasi-natural experiment approach. They find that this supervision enhances corporate carbon performance within a short time frame. Tang et al. (2023), in an empirical study of Chinese thermal power enterprises, demonstrate that China's "ultra-low emission retrofit" policy significantly enhances CEP. Deng et al. (2023) examine the effects of China’s Environmental Protection Tax Law on heavily polluting companies. Their empirical analysis indicates that the implementation of the environmental tax has a positive impact on promoting green technological innovation within these firms. Beyond the aforementioned external factors, recent research indicates that government environmental subsidies (Luo et al., 2024b), the development of a social credit system (Cui et al., 2023), the inauguration of high-speed rail (Luo et al., 2024a), and green financial policies (Chen et al., 2024b) are also pivotal in enhancing CEP.

Regarding the internal factors that shape CEP, a significant body of scholarly work has, in recent years, delved into the influence of executives' gender (Fan et al., 2023), military background (Zhang et al., 2022), educational qualifications (Zhang et al., 2024), environmental consciousness (Liu and Cao, 2024), and international experience (Chen et al., 2023) on corporate environmental governance, drawing on Upper Echelon Theory (Hambrick and Mason, 1984) and Imprint Theory (Marquis and Tilcsik, 2013). These inquiries have produced a wealth of scholarly findings. Additionally, research has examined the impact of stakeholder engagement and attention on CEP. For example, Wang et al. (2023) uncovered a positive correlation between retail investor attention and CEP. Chen et al. (2024a) demonstrated that an increase in green fund holdings can improve CEP. Li et al. (2024c) posited that public environmental concern, as a key form of informal environmental regulation, can impose pressure on corporate management to enhance environmental investments. Empirical analyses from their study have substantiated this assertion. Moreover, with the emergence of the digital economy, growing evidence indicates that corporate digitalization, through digital innovation (Liu et al., 2023; Wang and Yang, 2024) and digital transformation (Shen et al., 2023; Wang and Li, 2023), offers vital opportunities for businesses to achieve pollution reduction, carbon emission mitigation, and sustainable green development.

Impact of government procurement

As a key instrument of modern public finance, the impact of government procurement on market economic activities has drawn considerable scholarly interest. Existing international studies have provided valuable insights into the role of government green procurement (GGP) in shaping corporate environmental behavior, which offers a critical

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comparative perspective for understanding China's context. For example, research in the EU context has shown that GGP stimulates corporate green innovation primarily through stable market demand and regulatory signaling (Edler and Georghiou, 2007; Krieger and Zipperer, 2022). A study of German firms found that public procurement contracts reduce the uncertainty of green R&D investments, leading to increased patent applications for environmental technologies (Aschhoff and Sofka, 2009). In contrast, a cross-country analysis by Crespi and Guarascio (2018) revealed that GGP's impact on innovation is more pronounced in industries with high competitive intensity, similar to the heterogeneity observed in China's market.

However, institutional differences between China and Western economies may lead to divergent corporate responses. In Europe, GGP often operates within a mature market system with strong private sector participation, while China's transition economy features a significant state-owned enterprise (SOE) sector and distinct policy implementation mechanisms. For instance, SOEs in China may respond to GGP not only for market incentives but also due to political mandates, whereas private enterprises in Europe are driven primarily by profit motives (Zhang and Zhu, 2024). Additionally, China's unique policy ecosystem—such as the integration of green development into national strategic plans—creates a more intensive policy push compared to the decentralized governance models in some Western countries.

Due to the substantial scale of government procurement orders and their capacity to provide businesses with a stable cash flow, several studies have concentrated on the effects of government procurement on corporate R&D and innovation activities (Edler and Georghiou, 2007; Wesseling and Edquist, 2018). The role of government procurement in enhancing employment (Holden and Sparrman, 2018), fostering rural entrepreneurship (Guo et al., 2024b), improving corporate investment efficiency (Cohen and Li, 2020), and elevating corporate ESG performance (Huang et al., 2023; Li and Cao, 2023) has also been substantiated by empirical research.

With the salience of global warming and environmental pollution, an increasing number of scholars are turning their attention to the green incentive effects of government procurement. The extant literature on the environmental effects of government procurement has predominantly focused on its influence on corporate green technological innovation (Ghisetti, 2017; Kou et al., 2024; Cheng et al., 2024; Tan et al., 2024), with studies consistently affirming the efficacy of GGP in bolstering corporate green innovation capabilities. Moreover, recent research has established a positive correlation between GGP and corporate ESG performance (Huang et al., 2023; Li and Cao, 2023; Wang et al., 2024d). Notably, while several studies have investigated the impact of GGP on corporate pollution emissions (Zhang and Zhu, 2024), corporate pollution management performance is a multifaceted concept that includes not only emissions and waste management but also energy efficiency, environmental responsibility, and environmental standards of products. Consequently, the impact mechanism of government procurement on CEP necessitates additional empirical validation.

This research comprehensively explores the capability of GGP to boost CEP and delves into the mechanisms that support this enhancement. Additionally, using text analysis to detect government green procurement orders, this study seeks to more accurately assess the impact of these green procurement practices on corporate incentives and actions in environmental governance.

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Hypothesis development

Direct effect of government green procurement on corporate environmental performance

In practice, due to the highly asymmetric distribution of costs and benefits associated with environmental governance, enterprises often lack sufficient incentive to proactively engage in such efforts. However, when the government participates in economic activities as a consumer, it can effectively encourage enterprises to participate in pollution control through demand-side guidance. This occurs as businesses are incentivized to adhere to the environmental protection standards established by government entities (Tian et al., 2024).

Compared with other market participants, the government, as the largest buyer in the market (Hang and Zhan, 2023), can provide stable and substantial demand for green products, thereby ensuring a steady cash flow for enterprises (Liu et al., 2024). Government procurement contracts not only enhance corporate profitability but also serve as a testament to the company's reputation and quality. This positive signal can attract additional resources and support from stakeholders. Furthermore, Liu et al. (2024) pointed out that government procurement has a strong demonstration effect on consumers, which can convey positive signals to the market, thereby strengthening consumers' green purchasing orientation and helping enterprises capture potential market demands.

Consequently, driven by the goal of maximizing profits, enterprises are strongly incentivized to compete for government procurement orders (Zhang and Zhu, 2024). To secure more GGP orders, companies must enhance their environmental performance through improvements in green production technologies and processes, the adoption of green raw materials, and the development of new environmental protection technologies, thereby meeting relevant environmental and procurement standards. Moreover, companies listed in the government procurement directory need to consistently upgrade their eco-friendly products or services to meet governmental standards, minimize pollutant emissions, and comply with advancing energy-saving and environmental protection regulations. This ensures ongoing enhancements in their environmental performance (Wang et al., 2024d).

Based on the aforementioned analysis, we propose Hypothesis H1:

H1: GGP can improve CEP.

Indirect effect of government green procurement on corporate environmental performance

According to principal-agent theory, information asymmetry leads to conflict of interest between corporate managers and shareholders. Driven by self-interest, enterprise managers are more inclined to pursue short-term profitable projects that yield quick results and have shorter return periods. This myopic focus diminishes managers' motivation to enhance corporate green governance capabilities and fulfill environmental responsibilities (Krieger and Zipperer, 2022; Smulowitz et al., 2023). When a company is listed on the government's green procurement roster, it experiences a significant boost in external visibility and transparency. This heightened exposure subjects the firm to increased oversight from a range of parties, including the media, public, and investors, thereby enforcing stricter external monitoring (Wang et al., 2024d). In this highly transparent environment, any environmental violations, such as illegal pollutant discharges, can rapidly attract negative public attention once exposed by the media. Such

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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incidents may not only tarnish the company's reputation but also trigger adverse reactions in the capital market, imposing market-level constraints and governance on corporate management (Clarkson et al., 2008; Gu et al., 2021). Consequently, under the governance pressure from stakeholders, enterprises listed in the green procurement program will inevitably enhance their environmental awareness and prioritize environmental responsibility to avoid potential market penalties and reputational damage (Zheng and Wen, 2024).

Based on the aforementioned analysis, we propose Hypothesis H2:

H2: GGP can enhance executive's green cognition, thereby improving CEP.

Extensive theoretical studies and empirical evidence have consistently shown that green technology innovation (GTI) is pivotal for improving corporate pollution control capabilities and facilitating green transformation (Wang et al., 2024c; Li et al., 2024b). Government green procurement (GGP) offers robust market return incentives for corporate engagement in green innovation activities. On one hand, the green procurement list sends a clear market signal to enterprises that the government has a demand for green products, technologies, and services (Zheng and Wen, 2024). This signal can guide enterprises to realign their R&D and production activities, increasing investment in the development of green technologies and products, thereby fostering corporate green innovation. On the other hand, securing government green procurement orders can yield economic benefits and market recognition for businesses (Liu et al., 2024). Such incentives can ignite corporate green innovation, as businesses recognize that green innovation is essential not only for social responsibility but also for bolstering product competitiveness, securing government orders, and enhancing profitability (Zhang and Zhu, 2024). Moreover, the unpredictability of returns on green innovation significantly impedes corporate willingness to innovate greenly (Kou et al., 2024). Government procurement orders, by providing stable market demand and anticipated returns, can mitigate the uncertainty and risks associated with corporate green innovation, further incentivizing businesses to pursue green innovation (Cheng et al., 2024).

Based on the preceding analysis, we formulate Hypothesis H3:

H3: GGP can promote corporate green innovation, thereby improving CEP.

Theoretically, to comply with environmental protection standards and government procurement requirements, enterprises will proactively increase their terminal environmental protection investments to secure government contracts and gain market recognition (Zhang and Zhu, 2024). On the one hand, in pursuit of environmental performance goals, enterprises listed under the Government Green Procurement (GGP) program are highly motivated to enhance their environmental protection investments and acquire advanced end-of-pipe treatment equipment. This not only improves their pollutant treatment capabilities but also reduces pollution emissions. On the other hand, from a funding perspective, GGP enhances enterprises' market profitability and brand value, thereby providing financial support for environmental protection investments (Wang et al., 2024d). By securing GGP orders, enterprises can not only achieve stable economic benefits but also enhance their market competitiveness and brand image, attract more consumers and investors, alleviate financing constraints, and allocate more resources towards pollution control equipment and other environmental protection initiatives. This ultimately improves the overall performance of enterprises' environmental governance (Zheng and Wen, 2024).

Based on the preceding analysis, we formulate Hypothesis H4:

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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H4: GGP can incentivize enterprises to increase investment in environmental protection, thereby enhancing CEP.

Fig. 1 illustrates the conceptual framework guiding this study. The figure was visualized using Visio software, which helped to systematically present the logical relationships and structural hierarchy within the framework.

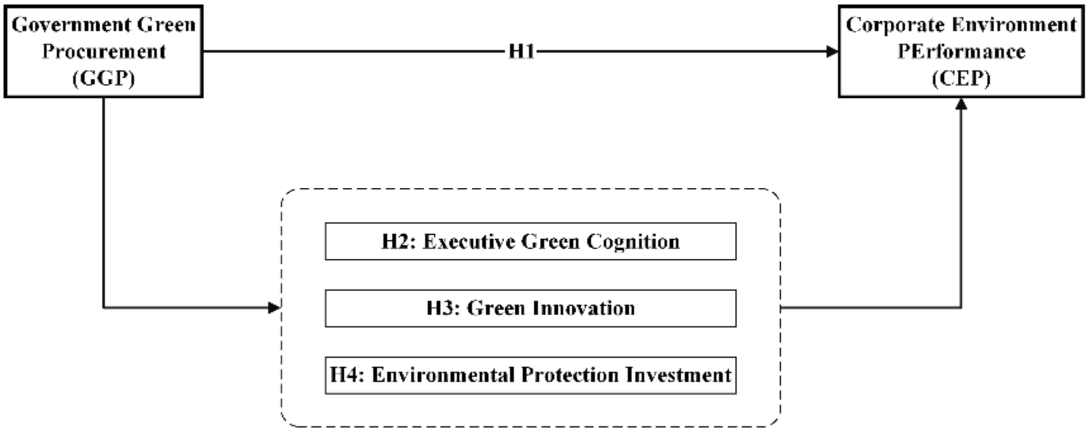

Figure 1. *Theoretical analysis frame diagram*

Materials and methods

Sample selection and data sources

To investigate the impact of government green procurement (GGP) policies on CEP, this study focuses on China's A-share listed companies from 2015 to 2022. The industry sectors covered in this study encompass 12 non-financial industries: agriculture, forestry, animal husbandry, fishery, and mining; manufacturing; electricity, heat, gas, and water production and supply; wholesale and retail trade; transportation, storage, and postal services; information transmission, software, and information technology services; real estate; leasing and business services; water conservancy, environmental protection, and public facilities management; as well as education.

The study commences in 2015 following the introduction of the Regulations on the Implementation of the Government Procurement Law of the People's Republic of China. The government procurement agreements are retrieved from the China Government Procurement Network (https://www.ccgp.gov.cn), whereas the corporate environmental performance metrics are sourced from CNRDS. Supplementary variable information is obtained from CSMAR. To reduce estimation bias, we adhere to conventional methods found in the literature and preprocess our data in the following manner: (1) we omit firms belonging to the financial sector; (2) we eliminate companies that have special treatment (ST, *ST) statuses or lack crucial variables; (3) we apply a 1% winsorization to all continuous variables to lessen the impact of outliers. In the end, our dataset consists of 20,639 observations spanning 3,365 publicly listed companies.

In the following text, all tables and figures were subjected to data processing and visualization using Stata software.

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Variable definitions

Dependent variable: corporate environmental performance (CEP)

Given that a single indicator cannot comprehensively capture the efforts enterprises make in environmental governance and assuming environmental responsibilities, we adopt the practices proposed by scholars such as Xiao and Shen (2022) and Li et al. (2024a), utilizing a composite measure of corporate environmental behaviors to evaluate CEP. Specifically, we selected eight variables that collectively reflect CEP and used the aggregated value of these variables as our dependent variable (*CEP*). *Table 1* provides a comprehensive overview of the definitions and evaluation standards for the eight variables.

Table 1. *Corporate environmental performance scoring criteria*

Primary indicator	Secondary indicators	Scoring criteria
Corporate environmental performance	Development and implementation of environmentally beneficial products	1 point is awarded if it occurs, and 0 points are given otherwise.
	Pollution reduction measures	1 point is awarded if it occurs, and 0 points are given otherwise.
	Circular economic policies	1 point is awarded if it occurs, and 0 points are given otherwise.
	Energy-saving measures	1 point is awarded if it occurs, and 0 points are given otherwise.
	Green office policies	1 point is awarded if it occurs, and 0 points are given otherwise.
	ISO 14001 certification	1 point is awarded if it occurs, and 0 points are given otherwise.
	Recognition and positive evaluations for environmental efforts	1 point is awarded if it occurs, and 0 points are given otherwise.
	Other environmental advantages	1 point is awarded if it occurs, and 0 points are given otherwise.

Based on the literature review, this set of measurement standards effectively captures the comprehensive efforts made by enterprises in environmental governance and has been widely validated in academic research (Wang et al., 2024b; Li et al., 2024d). In the robustness test section, this paper will also conduct alternative tests on the dependent variable using methods such as "E" performance from ESG metrics.

Core explanatory variable: Government green procurement (Green)

In accordance with the research designs of Wang et al. (2024a) and Liu et al. (2024), the construction process of the variable "government green procurement" (*Green*) is as follows:

First, we collected government procurement agreements spanning from 2015 to 2022 from the China Government Procurement Network. These agreements contain comprehensive details, including the contract title, contract identifier, buyer's name, vendor's name, primary subject description, and the contract amount.

Second, we extracted keywords from three key documents: the "List of Government Procurement of Environmental Label Products," the "List of Government Procurement of Energy-Saving Products," and the "Basic Requirements for Government Procurement of Green Buildings and Green Building Materials." Using these keywords, we built a

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comprehensive green procurement keyword library. Subsequently, employing text analysis techniques, we identified government green procurement contracts by verifying whether the "contract title" and "main subject name" contained specific environmental and energy-saving keywords.

Third, we compiled a list of listed companies and their subsidiaries and matched them with the supplier names in the government procurement data on an annual basis to obtain the government procurement contracts of listed companies each year. Following the methodology of Zhang and Zhang (2024), we treated GGP as a “policy shock”. Specifically, companies with GGP contracts were classified as the treatment group, indicating that they were influenced by GGP, while companies without GGP contracts served as the control group. If a company was listed on government green lists in a given year, its *Green* value was set to 1 for that year and all subsequent years.

Control variables

In line with the methodologies employed by previous researchers (Yang and Han, 2023; Wan et al., 2024; Li et al., 2025), we have chosen the following variables to serve as control variables: firm size (*Size*), firm age (*Age*), debt-to-asset ratio (*Lev*), main business income growth rate (*Growth*), Tobin's Q value (*Tobin*), ownership concentration (*Top1*), board size (*lnBoard*), and the proportion of independent directors (*lnDep*). *Table 2* offers comprehensive details regarding the nomenclature, symbols, and definitions of the control variables. The summary statistics for each variable are shown in *Table 3*.

Table 2. *Definitions of control variables*

Variables	Definition
Size	Natural logarithm of total assets
Age	Natural logarithm of (1+ firm’s age)
Lev	Total liabilities/Total assets
Growth	Growth rate of main business income
Tobin	Market value of the company/total assets
Top1	Share proportion of the largest shareholder
lnBoard	Natural logarithm of the number of board members
lnDep	Natural logarithm of the proportion of independent directors

Table 3. *Descriptive statistics*

Variables	Obs	Mean	S.D.	Min	Max
CEP	20639	1.0519	1.8879	0	8
Green	20639	0.0593	0.1686	0	1
Size	20639	22.4674	1.3321	17.6413	28.6067
Age	20639	2.3809	0.6649	0.6931	3.4965
Lev	20639	0.4381	0.2031	0.0084	1.9566
Growth	20639	0.3586	0.9675	-0.8300	7.1960
Tobin	20639	2.1098	1.4760	0.8270	9.9147
Top1	20639	32.7900	14.4503	8.2300	72.3146
lnBoard	20639	2.2577	0.3032	0	3.4012
lnDep	20639	3.5924	0.5062	0	4.6151

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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Model specification

Based on the foregoing analysis, the government's green procurement of corporate products can be viewed as a form of "policy-induced impact." This provides an appropriate quasi-natural experimental setting for this study to employ a staggered DID model to evaluate the impact of GGP on CEP. The benchmark regression model is presented in *Equation (1)*:

$$CEP_{it} = \alpha_0 + \alpha_1 Green_{it} + \alpha_c Controls_{it} + \sum Firm + \sum Year + \varepsilon_{it} \qquad \text{(Eq.1)}$$

In Eq.1, *CEP* denotes the environmental performance of enterprises, Green signifies government green procurement, *Controls* represent a collection of control variables, while *Firm* and *Year* capture the fixed effects of firms and years, respectively. Standard errors are clustered at the enterprise level.

To address potential selection bias arising from non-comparable firm characteristics, this study employs Propensity Score Matching (PSM) to control inter-group characteristics within the sample. Specifically, we use all control variables from the baseline regression as covariates in a Logit model to estimate the propensity score of each firm being treated by GGP. A 1:1 nearest neighbor matching without replacement is applied to pair treated firms with control firms based on their propensity scores, ensuring that the matched groups are observationally similar in pre-treatment characteristics. This approach helps to mitigate endogeneity issues by creating a counterfactual group that closely resembles the treated group in observable traits (See PSM-DID section).

Results

Baseline regression results

The regression results examining the impact of government green procurement (GGP) on CEP are presented in *Table 4*. Column (1) shows the estimation results without control variables and without accounting for two-way fixed effects, while Column (2) includes two-way fixed effects. Columns (3) and (4) incorporate control variables; specifically, Column (3) does not account for two-way fixed effects, whereas Column (4) includes both control variables and two-way fixed effects. Across all four regression models, the coefficient estimate for the key explanatory variable Green remains significantly positive at the 1% statistical level, indicating that GGP effectively enhances CEP. These findings confirm Hypothesis H1.

Parallel trend test

The parallel trends assumption is a critical prerequisite for employing the DID model to examine policy effects. Specifically, in this study, prior to the signing of the government green procurement contract, there should be no significant differences in the mean environmental performance between the control and treatment groups. To examine whether this assumption is valid, this paper utilizes the event study approach introduced by Jacobson et al. (1993) to investigate the dynamic impacts on both the treatment and control groups in the periods preceding and following the “policy implementation.” Additionally, the following model is formulated:

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$$CEP_{it} = \beta_0 + \sum_{k=-5}^{5} \beta_k \times D_{i,t_0+k} + \beta_c Controls_{it} + \sum Firm + \sum Year + \varepsilon_{it} \quad \text{(Eq.2)}$$

In *Equation (2)*, D is a dummy variable, and t_0 denotes the current year. The regression results of *Equation (2)* are illustrated in *Fig. 2*, where the dashed lines represent the 90% confidence interval. The horizontal axis indicates the relative time of GGP impact on enterprises, while the vertical axis shows the estimated beta coefficients. It can be observed that the estimated coefficients prior to GGP shock fail to pass the 10% significance test, indicating no significant difference in environmental performance between the treatment and control groups before the intervention, thus confirming the parallel trend assumption. After GGP shock, the corresponding regression coefficients become significantly positive starting from *post1* period, suggesting that GGP can continuously enhance enterprises' environmental governance practices and improve their CEP.

Table 4. *Baseline regression results*

Variables	**(1) CEP**	**(2) CEP**	**(3) CEP**	**(4) CEP**
Green	1.0850***	0.2513***	0.3798***	0.2047***
	(0.1536)	(0.0788)	(0.1087)	(0.0751)
Size			0.7483***	0.5009***
			(0.0254)	(0.0391)
Age			0.1829***	-0.4558***
			(0.0352)	(0.0821)
Lev			-0.7459***	-0.4069***
			(0.1141)	(0.0966)
Growth			-0.0840***	-0.0219**
			(0.0156)	(0.0101)
Tobin			0.1180***	0.0854***
			(0.0147)	(0.0110)
Top1			0.0032*	0.0005
			(0.0017)	(0.0026)
lnBoard			0.1532***	-0.0706**
			(0.0594)	(0.0336)
lnDep			-0.0089	0.0267*
			(0.0240)	(0.0147)
Constant	1.0160***	1.0404***	-16.5227***	-9.0717***
	(0.0290)	(0.0023)	(0.5318)	(0.8955)
Firm FEs	NO	YES	NO	YES
Year FEs	NO	YES	NO	YES
N	20639	20639	20639	20639
Adj.R^2	0.0095	0.7135	0.2661	0.7210

Note: The definitions of each variable are presented in Table 2. "Constant" represents the constant term; "Firm FEs" and "Year FEs" denote the fixed effects of firm and year, respectively; "N" indicates the number of observations; "Adj.R^2" stands for the adjusted R-squared. Standard errors clustered at the firm level are reported in parenthesis; ***, ** and * indicate statistical significance at the levels of 1%, 5%, and 10% respectively, the same as below

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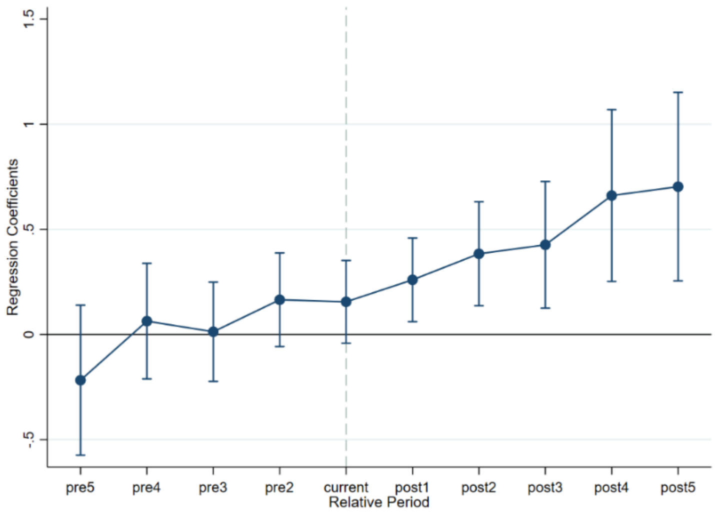

Figure 2. *Parallel trend test*

Robustness test

Placebo test

To avert the possibility that the results from the baseline regression are confounded by random or unobservable factors, we implement a placebo test by randomly extracting a "pseudo" treatment group.

In detail, we randomly select a subset of the dataset equivalent in size to the original treatment group, generating a "pseudo policy dummy variable" to supplant the *Green* variable within the baseline model for regression analysis. This random sampling procedure is conducted 1000 times. Subsequently, we extract the coefficients and delineate the distribution of these regression coefficients graphically. As depicted in *Fig. 3*, the estimated coefficients from the random extractions adhere to a normal distribution and are predominantly concentrated near the value of 0, with the majority of regression outcomes being statistically insignificant (*p<0.1*). Consequently, we can largely discount the notion that enhancements in CEP stem from random or unobservable factors, thereby validating the positive influence of GGP on CEP from a counterfactual standpoint.

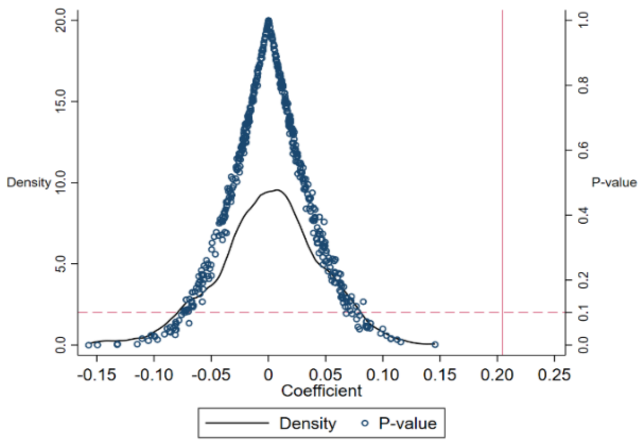

Figure 3. *Placebo test*

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Propensity Score Matching (PSM)

The balance test results for PSM are displayed in *Fig. 4*, showing that the standardized biases of most covariates are reduced to within 10% after matching, indicating effective balance between the treated and control groups. The PSM-DID estimation results in *Table 5,* column (1), show that the core explanatory variable Green has a coefficient of 0.2593, which is significantly positive at the 1% level. This confirms the robustness of the baseline findings, suggesting that the positive effect of GGP on CEP is not driven by selection bias.

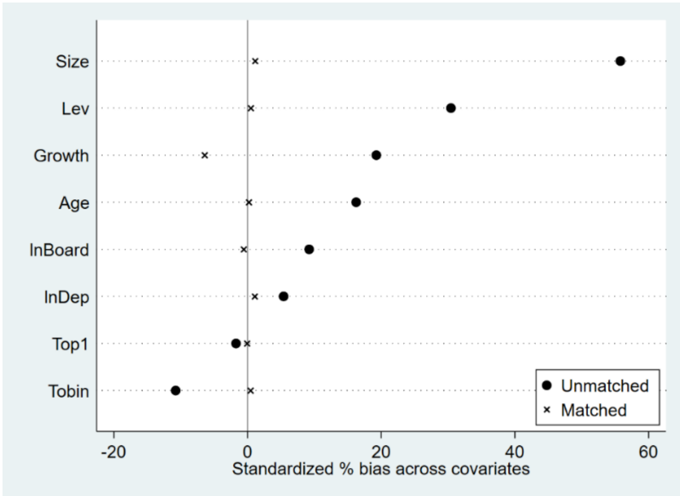

Figure 4. *Balance test results*

Table 5. *Endogeneity test*

Variables	**(1) CEP**	**(2) CEP**
Green	0.2593***	0.2113*
	(0.0796)	(0.1123)
Constant	2.5264***	1.5787
	(0.5903)	(0.9865)
Controls	YES	YES
Firm FEs	YES	YES
Time FEs	YES	YES
N	6060	20639
Adj.R^2	0.7205	0.7129

Entropy balancing

While Propensity Score Matching (PSM) can assist in identifying company samples with analogous attributes, its reliance on the initial Logit model is pronounced, and it often results in a diminished sample size (Hu et al., 2023). Consequently, we augment our analysis with the entropy balancing method as proposed by Hainmueller (2012), which constructs a new control group through the weighting of covariates. In detail, we apply weights to the mean, variance, and skewness of the covariates within the control group to align with those of the treatment group. This approach maintains the

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DOI: http://dx.doi.org/10.15666/aeer/2304_75937617

comparability between the treatment and control groups without reducing the sample size, enhancing the credibility of our findings (Godsell, 2022). *Table 6* illustrates the outcomes of entropy balancing. Before entropy balancing, there are notable statistical disparities in the characteristics of the covariates between the treatment and control groups. After entropy balancing, however, the control and treatment groups display remarkably analogous sample traits.

Table 6. *Results of entropy balance*

Variables	Treatment group			Control group (Before entropy balancing)			Control group (After entropy balancing)		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Size	23.4600	2.7260	0.6112	22.4400	1.7150	0.7371	23.4600	2.7260	0.6111
Age	2.5910	0.3075	-0.6232	2.3750	0.4448	-0.3874	2.5910	0.3075	-0.6234
Lev	0.5062	0.0306	-0.0944	0.4360	0.0414	0.3985	0.5062	0.0306	-0.0943
Growth	0.4858	0.6400	3.9430	0.3547	0.9446	4.5910	0.4858	0.6400	3.9430
Tobin	1.8130	1.5180	2.7430	2.1190	2.1960	2.7590	1.8130	1.5180	2.7430
Top1	31.9600	222.1000	0.5485	32.8200	208.4000	0.5533	31.9600	222.1000	0.5485
lnBoard	2.2820	0.0950	-0.8162	2.2570	0.0918	-0.6015	2.2820	0.0950	-0.8163
lnDep	3.6340	0.1627	-6.0980	3.5910	0.2590	-5.4280	3.6340	0.16270	-6.0980

Column (2) of *Table 5* presents the regression results following the implementation of the entropy balance method. The variable CEP remains significantly positive at the 10% level, which confirms that the conclusion regarding GGP's ability to enhance CEP is robust even after addressing potential sample bias.

Other robustness tests

To comprehensively validate the reliability of the benchmark regression findings, this paper additionally performed the following robustness checks:

(1) Replace the dependent variable

In the baseline regression model, we evaluate the environmental performance of enterprises using an environmental advantage score that encompasses eight dimensions. To ensure robustness, we adopt an alternative approach to measure CEP. Specifically, this study draws on the research design of Ren et al. (2023) and utilizes both the natural pair value of the "environment" (E) score from the CNRDS database and the E score from the Hua-Zheng ESG Index as proxy variables for CEP. *Table 7*, columns (1) and (2), present the regression results after substituting the E scores from the CNRDS database and the Hua-Zheng ESG index, respectively. The estimated coefficients for *Green* remain significantly positive at the 5% and 1% statistical levels, further validating the reliability of our benchmark regression results.

(2) Exclude industry samples without green procurement

We further exclude industry samples not covered by government green procurement to ensure that our research results more accurately reflect the actual impact of GGP on CEP. The estimated coefficient of the core explanatory variable, *Green*, is significantly positive at the 1% statistical level, thereby providing robust support for our research conclusions.

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Table 7. *Other robustness tests*

Variables	(1) lnE_CNRDS	(2) lnE_HZ	(3) CEP	(4) CEP
Green	0.0857**	0.0176***	0.2613***	
	(0.0409)	(0.0053)	(0.0802)	
Green_Int				0.6499**
				(0.2978)
Constant	2.1668***	4.0698***	1.7583***	-10.9398***
	(0.1519)	(0.0162)	(0.2512)	(1.1386)
Controls	YES	YES	YES	YES
Firm FEs	YES	YES	YES	YES
Time FEs	YES	YES	YES	YES
N	19693	20181	18774	20639
Adj.R^2	0.7276	0.5931	0.7134	0.7193

(3) Consider the intensity of government green procurement

A possible challenge to the research conclusion of this paper is that, even though the DID model is used to evaluate the ongoing impact of GGP on corporate environmental behavior, the differing quantities and values of government procurement contracts acquired by various companies in each fiscal year might introduce variability. This heterogeneity could potentially affect the robustness of the regression analysis. To address this concern, we draw on the research of Tian et al. (2024) and use the ratio of the total amount of GGP orders obtained by the enterprise to its operating income (*Green_Int*) as a substitute variable for the core explanatory variable (*Green*) to re-estimate model (1). The results presented in column (4) of *Table 7* indicate that the estimated coefficient for *Green_Int* is 0.6499, significant at the 5% level from a statistical standpoint. This indicates that our benchmark regression conclusions remain robust.

Mechanism analysis

As outlined in the previous theoretical discussion, GGP is expected to boost CEP through enhancing management's awareness of green practices, encouraging green innovation, and fostering greater investment in environmental protection measures. To test this proposition, we adopt the research design of Zhang and Zhu (2024) to further examine the impact of GGP on mediating variables, building upon the established evidence that GGP can improve CEP.

To test Hypothesis H2, we adopt the research design from Liu and Chen (2024) and Hao et al. (2024), employing text analysis to quantify the frequency of keywords related to executives' green cognition in the annual reports of listed companies. Specifically, the frequency of these keywords serves as a proxy for executives' green cognition (*EGC*). The results presented in Column (1) of *Table 8* indicate that GGP significantly enhances executives' green cognition, thereby improving CEP, thus validating Hypothesis H2.

For the measurement of corporate green innovation capability, we adopt the method widely recognized by scholars, specifically the natural logarithm of the number of green invention patent applications filed by enterprises (Kou et al., 2024). The results in Column (2) of *Table 8* indicate that the coefficient of *GGP* on corporate green innovation is significantly positive at the 5% statistical level. This suggests that GGP effectively enhances corporate green innovation capability, thereby improving environmental performance. These findings confirm Hypothesis H3.

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Table 8. *The results of the mechanism analysis*

Variables	(1) EGC	(2) GPat	(3) GInvest
Green	0.3369**	0.0883**	0.0150***
	(0.1418)	(0.0430)	(0.0050)
Constant	3.0209***	0.6158***	-0.1306***
	(0.4416)	(0.1100)	(0.0304)
Controls	YES	YES	YES
Firm FEs	YES	YES	YES
Year FEs	YES	YES	YES
N	20639	20639	18636
Adj.R^2	0.7334	0.7342	0.2877

Finally, we retrieved the environmental protection investment data of listed companies from the CSMAR database and utilized the ratio of environmental protection investment to total assets as a proxy variable (*GInvest*) to quantify the level of corporate environmental investment (Lu et al., 2024). The regression results presented in Column (3) of *Table 8* indicate that the estimated coefficient for Green is 0.0150, which is statistically significant at the 1% level. This result strongly corroborates Hypothesis H4, indicating that GGP can successfully motivate companies to increase their investments in environmental protection, which in turn enhances CEP.

Heterogeneity analysis

In the preceding analysis, we examined the impact of GGP on CEP and its underlying mechanisms. In this section, we will delve deeper into whether GGP yields differentiated policy effects across enterprises with varying characteristics and industries, thereby offering targeted policy recommendations to maximize the environmental benefits of GGP.

Enterprise ownership

In China, there exists an intrinsic distinction in ownership structure between state-owned enterprises (SOEs) and non-state-owned enterprises (NSOEs). To investigate the divergent impacts of GGP on CEP across these ownership structures, we stratified the sample based on the property rights characteristics of the enterprises into two categories: NSOEs and SOEs, and estimated model (1) for each group. The findings presented in *Table 9*, columns (1) and (2), reveal that in the NSOE sample, the coefficient for *Green* is 0.3801, significant at the 1% statistical level, whereas in the SOE sample, the coefficient for *Green* is 0.2203, significant only at the 10% level. Moreover, the statistical test comparing coefficients across the two groups shows that this difference is significant at the 1% level.

The underlying reasons for these results could be attributed to the fact that SOEs typically maintain closer relationships with the government, with their decision-making processes being more susceptible to the influence of policy directives and administrative commands. Conversely, NSOEs, as autonomous market participants, may exhibit greater sensitivity to market demands and a propensity to align their business practices with market signals. Moreover, NSOEs often confront more stringent financing constraints

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than SOEs. Government green procurement offers NSOEs supplementary market demand and liquidity, which can facilitate access to additional financing opportunities and mitigate financing costs. This, in turn, can lead to increased investments in environmental protection and green innovation, consequently improving environmental performance.

Table 9. *Heterogeneity analysis results based on enterprise ownership*

Variables	(1) NSOEs CEP	(2) SOEs CEP
Green	0.3801***	0.2203*
	(0.1153)	(0.1194)
Constant	0.8764***	2.3332***
	(0.2960)	(0.6011)
Controls	YES	YES
Firm FEs	YES	YES
Year FEs	YES	YES
Empirical p-value	0.160***	
N	12881	7651
Adj.R^2	0.6772	0.7220

Market competition degree

For companies in industries with varying degrees of market competition, the impact of GGP on environmental performance may differ. We employ the Herfindahl-Hirschman Index (HHI) to quantify the level of market competition within the industry and categorize the entire sample into high market competition (Low HHI) and low market competition (High HHI) groups based on the median HHI value for regression analysis. The results presented in *Table 10* indicate that in the high market competition subsample, GGP exerts a more pronounced effect on enhancing CEP. There is a difference of 0.349 in the coefficients when comparing the two regression groups, with this significance observed at the 1% level.

Table 10. *Heterogeneity analysis results based on market competition degree*

Variables	(1) High HHI CEP	(2) Low HHI CEP
Green	0.1568	0.5060***
	(0.1039)	(0.1643)
Constant	1.5635***	1.6398***
	(0.3654)	(0.4051)
Controls	YES	YES
Firm FEs	YES	YES
Year FEs	YES	YES
Empirical p-value	0.349***	
N	9182	8476
Adj.R^2	0.7158	0.7276

The possible explanation for this result may be attributed to the fact that in industries with high market competition (Low HHI), enterprises face intense competitive pressure, which drives them to adopt differentiated competitive strategies to gain market

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DOI: http://dx.doi.org/10.15666/aeer/2304_75937617

advantages. GGP serves as a clear market signal indicating demand for green products and environmentally friendly services, thereby providing companies in highly competitive industries with greater incentives to differentiate themselves by enhancing their environmental performance to attract both consumer and government orders.

Discussion

Theoretical implications

Extending the corporate environmental performance determinants literature

This study contributes to the understanding of CEP drivers by emphasizing the role of demand-side policy shocks. Existing research has primarily focused on supply-side regulations (e.g., environmental taxes, emissions standards) or internal corporate factors (e.g., executive characteristics, stakeholder engagement) (Tang et al., 2024; Wei and Peng, 2025). By contrast, we show that GGP, as a demand-side instrument, can proactively induce corporate environmental behavior through market signals, complementing the literature on policy-driven CEP improvements (Edler and Georghiou, 2007; Krieger and Zipperer, 2022).

Advancing the government procurement environmental effects discourse

While prior studies have explored GGP's impact on green innovation (Cheng et al., 2024; Liao et al., 2024), our research is among the first to systematically link GGP to comprehensive CEP improvements. We demonstrate that GGP's environmental benefits extend beyond innovation to include enhanced environmental management practices (e.g., investment in end-of-pipe treatment) and cognitive shifts in corporate leadership. This finding broadens the theoretical framework for analyzing GGP's environmental impacts, moving beyond narrow technological outcomes to encompass holistic corporate environmental governance.

Heterogeneity insights for institutional theory

The heterogeneous effects of GGP across ownership and market competition contexts provide nuanced insights for institutional theory. The weaker effect of GGP on state-owned enterprises (SOEs) reflects their distinct institutional environment, where political mandates may substitute for market-driven incentives. In contrast, the stronger effect in high-competition industries underscores the role of market forces in amplifying policy impacts.

Practical implications

From a practical perspective, the findings of this study offer significant implications for policymakers and corporate managers to leverage government green procurement (GGP) as an effective tool for promoting corporate environmental performance (CEP). For policymakers, the evidence that GGP significantly enhances CEP underscores the need to expand the scale and scope of green procurement initiatives. This can be achieved by increasing budget allocations for green products and services, regularly updating the green procurement list to reflect the latest environmental standards and technological advancements, and incorporating a broader range of industries and product categories to encourage more enterprises to engage in green supply chain practices. Given the stronger

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2304_75937617

effect of GGP on non-state-owned enterprises (NSOEs) and industries with high market competition, policymakers should design targeted strategies for these sectors—such as reducing entry barriers for NSOEs, providing specialized training and consulting services on green procurement, and implementing fiscal subsidies or tax incentives to alleviate their financial constraints during green transformation. In highly competitive industries, GGP can be used to set clear green benchmarks, leveraging market competition to drive enterprises to differentiate themselves through improved environmental performance. Additionally, integrating GGP with complementary policies—such as green R&D subsidies, tax incentives for environmental protection investments, and low-interest loans for green technology projects—can reinforce the mediating mechanisms of executive green awareness, green innovation, and environmental protection investment, creating a synergistic policy effect that enhances CEP holistically.

Limitations and future research

While this study advances understanding of GGP's impact on CEP, several limitations merit discussion. GGP measurement relies on text analysis of procurement contracts, which may not fully capture the intensity or quality of green procurement practices. Although PSM and DID methods address endogeneity, unobserved factors like corporate social responsibility orientation could still influence results. The temporal scope (2015–2022) reflects a specific period of China’s green policy development, limiting generalizability to other contexts.

Future research could expand samples to include private enterprises for cross-ownership comparisons, deepen GGP measurement by incorporating quantitative indicators (e.g., procurement scale, environmental standard stringency), and explore how regional institutional quality moderates GGP effects. Long-term impact analyses and cross-country comparisons between different economic contexts would further enrich the field, providing broader insights for sustainable policy design.

Conclusion

In this study, we consider the addition of enterprises to the government's green procurement list as a quasi-natural experiment. By employing a staggered difference-in-differences approach, we examine how government green procurement (GGP) influences corporate environmental performance (CEP) and explore the underlying mechanisms driving these effects. Our findings indicate that: (1) GGP positively influences CEP, a conclusion robustly supported by various tests including parallel trend tests, placebo tests, PSM-DID, and entropy balancing methods. (2) Mechanistically, GGP, as a significant demand-side policy instrument, enhances CEP by improving managerial green awareness, stimulating green innovation, and encouraging increased environmental protection investments. (3) The results of the heterogeneity analysis show that in the samples of state-owned enterprises and industries with higher levels of market competition, the positive effect of GGP on the improvement of enterprise environmental performance is more pronounced.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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