

# Government Subsidies and Environmental, Social, and Governance (ESG) Performance: Evidence from China

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## ABSTRACT

The challenges of climate change and pollution are driving more companies to focus on environmental, social and governance (ESG). It is possible to evaluate the implications of current subsidy policies and provide suggestions for novel approaches by comprehending the connection between government subsidies and ESG. In this paper, we constructed a panel database of Chinese A-share listed companies from 2010-2021, including government subsidies received by companies, ESG scores and other basic information and data. In addition, we explored the correlation between government subsidies and ESG and examined the moderating effects of financial constraints, green innovation and political connections. We find a U-shaped relationship between government subsidies and ESG for all our research samples. Besides, financing constraints, green innovation and political connections all negatively moderate the U-shaped relationship between government subsidies and ESG. Moreover, compared to firms with green behaviors, firms without green behaviors show more significant dampening and promoting effects between government subsidies and ESG.

## KEYWORDS

ESG; Government subsidies; U-shaped; Financing constraints; Green innovation; Political connections

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## 1. INTRODUCTION

ESG is an acronym for environment, social and governance, which is a mapping of the concept of sustainable development at the level of financial markets and micro-enterprises. ESG was originally proposed by the United Nations Environment Programme in “Who Cares Wins” in 2004. Compared to CSR, ESG focuses more on non-financial information, key issues and quantitative metrics. Since it was first presented, it has been emphasized by an expanding number of countries. The ESG concept not only meets the requirements of the new development concept of innovation, coordination, greenness, openness and sharing, but also complies with the strategic deployment of the Chinese “dual-carbon” target, and at the same time provides a quantifiable and operable management model for enterprises to practice low-carbon transformation. ESG is highly relevant to China’s sustainable development strategy, so how to improve the ESG scores of companies is a matter of concern.

The development of ESG in China started late, with numerous developmental resistances, insufficient knowledge of ESG concepts, insufficient resources and inputs, and lack of comprehensiveness, reliability and comparability of information disclosure [1]. Policies related to ESG can be traced back as far as 2006, when the Shenzhen Stock Exchange issued the “Guidelines for Social Responsibility of Listed Companies”, proposing that enterprises should voluntarily disclose corporate social responsibility reports. In 2018, the China Securities Regulatory Commission (CSRC) added for the

first time in the “Regulations on the Governance of Listed Companies” that enterprises should disclose ESG information in accordance with laws and regulations. In 2022, China set up its Bureau of Social Responsibility to better guide central enterprises to actively fulfil their social responsibilities. China’s ESG development started late but is developing rapidly, pulled by numerous policies and showing significant policy-orientated features.

Since the concept of ESG was introduced, scholars have mainly conducted research on the impact of ESG in three main areas: corporate finance [2, 3], financial markets [4, 5] and ESG itself [6, 7]. Corporate finance mainly includes the impact of ESG on corporate financial performance, market performance, risk management and other aspects. Financial markets include the relationship between asset pricing and ESG, investment decisions, investor behavior, etc. ESG itself includes the construction of ESG indicators, the quality of ESG data, the disclosure of ESG information, the ESG framework and other aspects.

The majority of recent research for government subsidies and ESG development concentrates on the unidirectional impact of government subsidies on ESG, or the relationship between government subsidies and corporate green innovation, and few studies have considered both the "crowding out" and "incentive" effects of government subsidies on ESG. The existence of a potential non-linear relationship has not been fully explored. Can government subsidies, as an important policy tool, promote ESG outcomes? Is there a non-linear relationship with ESG? What is the mechanism of its effect? Do multiple regions and various types of businesses differ in how government subsidies affect business ESG? This paper will focus on the above questions, which are of great practical significance for promoting ESG development and fulfilling corporate social responsibility in China, and can provide useful insights for the government to formulate and improve policies to promote green development of enterprises.

In light of this, this research empirically examines the effects of government subsidies on company ESG and the moderating effects of financial constraints, green innovation, and political affiliation, using companies listed on the Main Board of A-shares in China from 2011 to 2021 as the research sample. The possible contributions of this paper are: (1) To investigate the nonlinear correlation between government subsidies and corporation ESG ratings, which is more reasonable, comprehensive and objective than the one-way relationship in the previous literature, and helps to provide a reference for subsequent quantitative research on the green development of government subsidies. (2) Regarding financial constraints, green innovation, and political connections, the mechanism of government subsidies’ influence on corporate ESG scores is analyzed from both macro and micro perspectives, thus expanding the relevant studies on ESG scores.

The paper consists of seven sections structured as follows: Part I is an introduction, Part II includes a literature review and the establishment of research hypotheses, Part III constructs the empirical model and explains the relevant data, Part IV presents the results of the empirical analysis, Part V is a robustness check, and Part VI concludes with a summary and policy recommendations.

## **2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT**

Climate change is among the most significant and pressing issues the world is currently experiencing [8]. It displays more damaging and ambiguous effects than we had anticipated [9]. Solving the problem of climate change is key to achieving sustainable development for humanity in the future [10]. For this reason, governments have introduced various policies to limit corporate carbon emissions, including legal restrictions [11], carbon trading markets and carbon taxes. One of the earliest developments in corporate green behavior was CSR, which centered on the idea that companies should not only pursue economic benefits, but also consider their social and environmental impacts and take action to mitigate or eliminate them [12]. Then it evolved into ESG, where a

company's ESG score is a composite indicator of a company's environmental, social and governance diversity, which reflects the company's level of greenness.

In the existing studies, many scholars have conducted detailed analyses of the factors influencing the ESG performance of firms. Previous studies have analyzed ESG from the perspective of firm size [13], rating agencies, environmental uncertainty, banking relationships [14], ownership structure, etc. Companies with higher ESG scores have lower financial risk and are undervalued in the stock market due to a positive risk premium, resulting in better stock market excess returns for companies with high ESG scores. However, it has been suggested that there is no connection between an investment's predicted excess returns and the value of the ESG score and that high ESG performance at the firm level mainly affects the risk characteristics of the stock and does not represent undervalued characteristics and therefore does not lead to excess returns [15].

Governments seek to mitigate the pressures of climate change mainly through both environmental regulation and subsidy incentives. The Porter hypothesis suggests that environmental regulation, based on legal enforcement measures, can stimulate firms to innovate and further increase their productivity [16], causing an upsurge in the market value of the enterprise, which is also an important factor influencing ESG. Government subsidies, on the other hand, are generally considered as market instruments and are aimed at supporting investment, protecting distressed firms, and protecting jobs. Much of the current research on government subsidies has focused on their effects on innovation and firm performance. Government subsidies have a complicated nonlinear connection with business innovation, and government subsidies can only contribute positively to firm innovation within a certain interval. While the majority of academics argue that government subsidies can increase corporate value, others believe that they have a considerable detrimental effect on firm performance.

As the direct economic benefits of green behavior are long-term and untimely, if firms invest too much and do not receive immediate economic returns, their incentive to engage in green behavior is reduced, but government subsidies can provide timely compensation. However, owing to informational asymmetries between the authorities and businesses, government subsidies are likely to have a "certificate effect", and firms are likely to invest the funds received in other non-green behavioral investments that yield better returns on inputs, such as investment in fixed assets, increasing investment in green energy, and increasing investment in green energy, increasing R&D spending, improving employee benefits, reducing corporate debt, etc.

Government subsidies tend to have both crowding out and incentive effects on subsidized firms. On the one hand, government subsidies can significantly increase firms' green innovation, increase firms' socially responsible behavior [17], increase information disclosure, reduce corporate financing constraints and increase media attention to influence ESG scores directly or indirectly. Also, government grants can possess a "signaling effect" in that enterprises that receive funds may attract the attention of outside investors, boosting their ability to compete on the capital market while promoting ESG ratings. However, because of information asymmetry, unfavorable environmental externalities, and greenwashing, government subsidies may swamp out ESG. When subsidies are granted without sufficient transparency and accountability, it is difficult to assess whether the recipients are truly committed to ESG practices. Lack of transparency can lead to greenwashing, where companies seek subsidies without making meaningful efforts to improve their ESG performance. At the same time, government subsidies may inadvertently lead to negative environmental externalities, and subsidies to high carbon emitting industries may encourage companies to continue environmentally harmful practices, defeating the original purpose for which ESG was created.

At the initial distribution of government subsidies, the government usually allocates the subsidy funds to firms or groups that have performed well in certain areas [18]. Therefore, the high ESG scores of firms receiving lower government subsidies may be due to the fact that the firms that initially receive government subsidies have already achieved better results in ESG. With the implementation of the

subsidy policy and over time, firms with good ESG performance are more willing to devote resources and funds to improve their ESG performance. And higher government subsidies can provide them with more financial support so that they can take more measures to improve their ESG performance, such as improving environmental management, promoting employee welfare and training, strengthening corporate governance and green transportation. Also, the high-level subsidies firms can share a portion of their subsidies with consumers, it can get more profit due to the increased market. Thus, firms with high government subsidies may have high ESG performance. Compared to firms with high government subsidies, firms with medium government subsidies may face more challenges, such as intense competition, limited resources or lack of a clear ESG strategy, and they may not have sufficient funds and resources to improve their ESG performance across the board, which may result in lower ESG scores. Therefore, the paper proposes the following hypothesis:

H1: Government subsidies and ESG share a U-shaped connection.

Financial constraints are the limitations and restrictions that businesses have while seeking external funding, like bank loans, bond issuance, and equity financing [19]. Firms with high financial constraints are less efficient in their operations and less competitive in the market due to limited investment, increased financial risk, and excessive debt pressure. Government subsidies have a crowding-out impact on enterprises' green conduct because of severe environmental externalities and information asymmetries within government agencies and companies. As a result, businesses with significant financial constraints are less likely to participate in green activity. Government subsidies, however, will enhance businesses' reputation, which will alleviate their financial constraints to some extent and increase their willingness to engage in green behavior. As a result, this paper puts forward the hypothesis that follows:

H2: The U-shaped link between government subsidies and ESG is moderated by financial constraints.

Green innovation involves managerial and technical advancement that aims to safeguard the ecosystem and environment. On the one hand, companies that have invested heavily in green innovation may have reached a tipping point of diminishing marginal returns on their green investments and government subsidies' influence on their businesses' green behavior might be dwindling. From a market leadership and competitive advantage perspective, companies with high levels of green innovation may already have some degree of market leadership and competitive advantage in the sustainability market, and they may already have a good reputation for attracting environmentally and socially responsible investors over the long term, and external financial incentives such as government subsidies are unlikely to provide further incentives for green behavior by internal managers and green investment by external investors. On the other hand, for firms with low green innovation, government subsidies create a kind of incentive for green behavior in order to reduce costs, mitigate risks and create a competitive advantage, while at the same time providing external signals that stimulate a positive domino effect for firms to implement green behavior.

H3: The U-shaped link between government subsidies and ESG is moderated by green innovation.

Political connections are an informal, special business relationship between a company's managers or shareholders and government agencies. It is mainly manifested by the fact that the firm employs or has employed government officials as managers. On the one hand, politically connected firms may be prone to rent-seeking behavior, and firms receiving subsidies may have limited regard for their own interests or for maintaining the government-business relationship rather than for environmental and social goals. At the same time, politically connected firms are more likely to be accused of greenwashing, their use of government subsidies will be scrutinized by stakeholders, and the incentive impact of government subsidies will be lessened as businesses will put more time and effort into completing disclosures. On the other hand, for non-politically connected firms, especially those with low ESG levels, the firm's political connections may be a signalling mechanism for the firm's good prospects and social reputation in the presence of information asymmetry, so the subsidies received by politically connected private firms can be used to promote R&D, investment and performance, or

to generate more local employment and tax revenue. Companies see government subsidies as an opportunity to improve their ESG practices and social reputation, and the financial support provided can also improve their competitive position, balance the competitive market environment and provide continuous positive feedback to further improve corporate ESG performance.

H4: The U-shaped link between government subsidies and ESG is moderated by political connections.

### 3. ECONOMETRIC MODEL DESIGN AND DATA

#### 3.1. Model

The section headings are in boldface capital and lowercase letters. Second level headings are typed

$$\ln ESG_{i,t} = \alpha_0 + \alpha_1 \cdot \ln SUB_{i,t} + \alpha_2 \cdot \ln^2 SUB_{i,t} + \alpha_3 \cdot Controls_{i,t} + \theta_t + \mu_j + \varepsilon_{i,t} \quad (1)$$

$$\ln ESG_{i,t} = \beta_0 + \beta_1 \cdot \ln SUB_{i,t} + \beta_2 \cdot \ln^2 SUB_{i,t} + \beta_3 \cdot FC + \beta_4 \cdot \ln SUB_{i,t} \times FC + \beta_5 \cdot \ln^2 SUB_{i,t} \times FC + \beta_6 \cdot Controls_{i,t} + \theta_t + \mu_j + \varepsilon_{i,t} \quad (2)$$

$$\ln ESG_{i,t} = \gamma_0 + \gamma_1 \cdot \ln SUB_{i,t} + \gamma_2 \cdot \ln^2 SUB_{i,t} + \gamma_3 \cdot GI + \gamma_4 \cdot \ln SUB_{i,t} \times GI + \gamma_5 \cdot \ln^2 SUB_{i,t} \times GI + \gamma_6 \cdot Controls_{i,t} + \theta_t + \mu_j + \varepsilon_{i,t} \quad (3)$$

$$\ln ESG_{i,t} = \delta_0 + \delta_1 \cdot \ln SUB_{i,t} + \delta_2 \cdot \ln^2 SUB_{i,t} + \delta_3 \cdot PC + \delta_4 \cdot \ln SUB_{i,t} \times PC + \delta_5 \cdot \ln^2 SUB_{i,t} \times PC + \delta_6 \cdot Controls_{i,t} + \theta_t + \mu_j + \varepsilon_{i,t} \quad (4)$$

Equation 1 is designed to explore the nonlinear connection between government subsidies and a firm's ESG score. Here, the explanatory variable is the natural logarithm of the ESG score of company *i* in year *t*.  $\ln^2 SUB_{i,t}$  is the squared term of a natural logarithm of overall government subsidies, whose coefficients are the regression coefficients of primary interest. It demonstrates a non-linear U-shaped association between government subsidies and ESG if it is significantly positive; otherwise, it reveals an inverted U-shaped association.  $Controls_{i,t}$  are the control variables in this paper, including ROA, Size, Lev, Growth, Board, Indep, Dual, FirmAge (See table 1 for detailed data definitions). Finally,  $\theta_t$  represents the time fixed effect, the industry fixed effect is denoted by  $\mu_j$  and  $\varepsilon_{i,t}$  the error term.

Equations 2-4 examine the potential moderating mechanisms, which are FC (financing constraint), GI (green innovation) and PC (political association) (See table 1 for detailed data definitions.). The coefficients  $\beta_5$ ,  $\gamma_5$  and  $\delta_5$  of the cross products of the quadratic term of the primary government subsidy and the moderating variable are positive to indicate that the corresponding moderating variable is positively moderated, and negative to indicate otherwise. The remaining variables are comparable to those in equation 1.

**Table 1.** Overview of variables

Variable	Description	Definition
lnESG	ESG Score	ln (ESG Score of the company +1)
lnSUB	Government subsidy	ln (government subsidy +1)
FC	Financial constraint	SA Index
GI	Green innovation	the firm's total number of green patents for the current year (including green utility patents and green invention patents)
PC	Political connection	PC is a dummy variable, if any one of the chairman and general manager of the enterprise is or has been a government officer, PC takes 1, otherwise it takes 0.
ROA	Return on assets	Net profit/average balance of total assets
Size	Size of the business	ln (Total assets at end of year+1)
Lev	Gearing ratio	Total liabilities at end of year/total assets at end of year
Growth	Growth rate of operating revenue	Current year operating income/previous year operating income - 1
Board	Number of directors	ln (Number of boards of directors+1)
Indep	Proportion of independent directors	Independent directors/total number of directors
Dual	Dual role of chairman and CEO	Dual is a dummy variable, if the chairman and general manager are the same person, Dual is 1, otherwise it is 0.
FirmAge	Years of company establishment	ln (Current year - year of establishment of the company +1)

### 3.2. Data

The natural logarithm of the ESG scores serves as the main explanation variable in this study. Because of concerns about sample size and accessibility of data, Sino-Securities Index ESG data were selected as proxy variables in this paper, and further Hexun ESG scores were selected in subsequent robustness tests. Government subsidies are the primary explanatory variable in this study, and the proxy variable is the natural logarithm of the amount for the current period under the government subsidies item in the other income in the notes to the company's balance sheet. Three distinct moderating factors were selected for this research: (1) The SA index, which solely includes the exogenous variables firm size and firm age, serves as a proxy for the financing constraint variable. (2) As a proxy variable for green innovation, the firm's total number of green patents for the current year (including green utility patents and green invention patents) is chosen. (3) A political connection dummy variable that takes the value of 1 if either the chairman or the general manager of the company is or was a government official, and 0 otherwise, is used to calculate political connection.

To verify the connection between government subsidies and ESG ratings, the study selects a sample of companies listed on the Main Board of A shares in China from 2011 to 2021, and the main data sources are as follows: (1) ESG data from Sino-Securities Index ESG database and Hexun ESG database. (2) Government subsidy, financial constraint and public connection from the CSMAR corporate database. (3) Statistics about green innovation were collected from the China Research Data Service (CNRDS) and the World Intellectual Property Organization (WIPO) Green Patent IPC categorization list. (4) The remaining control variables were collected from the CSMAR database.

The descriptive statistics for the primary variables are given in Table 2, where the ESG score fluctuates between a minimum of 3.628 to a maximum of 4.528, with a mean of 4.306. The amount of government subsidies received by various enterprises differs considerably with a minimum value of 0 and a high value of 23.11, with a standard deviation of 6.535. The lnSUB had 4,684 sample observations of 0, representing 19.99 % of the total sample. Financing constraints had a mean value of 4.766 and a range of -1.160 to 14.04. Green innovation had a mean score of 4.04, a minimum score

of 0, and a maximum score of 1383. With a maximum of 1 and a low of 0, political connection had a mean of 0.326.

**Table 2.** Descriptive statistics

VARIABLES	(1)	(2)	(3)	(4)	(5)
	N	SD	mean	min	max
lnESG	23,430	0.072	4.306	3.628	4.528
lnSUB	23,430	6.535	12.54	0	23.11
FC	23,430	1.635	4.766	-1.160	14.04
GI	23,430	30.76	4.040	0	1,383
PC	23,430	0.469	0.326	0	1
Growth	23,430	0.419	0.192	-0.648	4.330
Board	23,430	0.198	2.135	1.609	2.708
Indep	23,430	0.0538	0.375	0.273	0.600
Dual	23,430	0.446	0.274	0	1
FirmAge	23,430	0.359	2.824	1.099	3.611
Size	23,430	1.336	22.18	15.58	28.64
Lev	23,430	0.209	0.420	0.00708	1.650
ROA	23,430	0.06	0.046	-1.324	0.880

Note: SD means standard deviation.

## 4. EMPIRICAL RESULTS AND DISCUSSIONS

### 4.1. Baseline Estimation Results

The outcomes of the baseline regression for model 1 are displayed in Table 3. We emphasize the quadratic coefficient of government subsidies for testing hypotheses 1. Without any control variables or fixed effects, the quadratic coefficient of government subsidies in column 1 is 0.0003 and is significant at the 1% level. After the control variable accounts for the influence of the government subsidies into consideration, the quadratic coefficient on government subsidies is still significant at the 1% level in column 2. At the 1% level of statistical significance, the quadratic coefficient of the year and industry fixed effects in column 3 is 0.0004, which is statistically significant. After accounting for all control variables and fixed effects, Column 4 depicts the regression, and the outcome reveals that the quadratic coefficient of government subsidies is 0.0001, which is statistically positive at the 1% level. As a result, Hypothesis 1 is examined since it is suggested that there is a U-shaped non-linear link between government subsidies and firms' ESG scores. The low level of government subsidies will lead to enterprises focusing more on short-term profits and reducing their investment in ESG, so ESG levels will first decline. However, as subsidies continue to increase to a certain level, firms will have more resources to spend on ESG investments. At the same time, high levels of subsidies may impose more ESG obligations, prompting firms to improve their ESG performance.

When governments introduce subsidy policies to encourage ESG behavior, the implementation of new ESG practices by companies adopting new green technologies or processes may involve higher transition costs, and these initial transition costs may lead to a temporary decline in ESG performance before the benefits of the government subsidies become apparent. At the same time, there may be a time lag in the emergence of factors influencing government subsidies on ESG, and coupled with the long-term, non-payback nature of corporate green behavior, the positive effects of corporate green investments may not be realised immediately. Furthermore, if the use of government subsidies lacks rationality and the development of the demand side of the market does not keep pace with the progress

of the supply side of companies, leading to environmental degradation and market imbalances, corporate green investment may instead have a negative impact.

**Table 3.** Baseline results

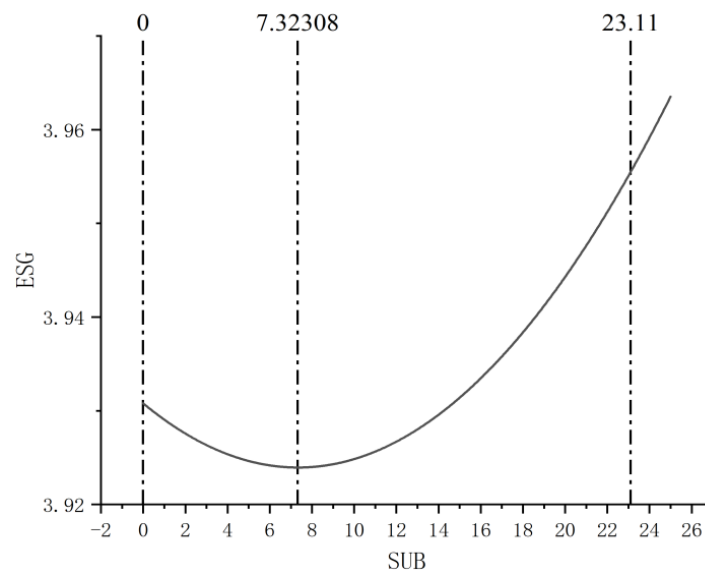
VARIABLES	(1)	(2)	(3)	(4)
	lnESG	lnESG	lnESG	lnESG
lnSUB	-0.005246*** (-16.485036)	-0.001195*** (-3.641385)	-0.005415*** (-10.276637)	-0.001866*** (-3.829930)
lnSUB2	0.000297*** (16.339512)	0.000045** (2.354853)	0.000385*** (11.907577)	0.000127*** (4.214330)
ROA		0.171982*** (23.084728)		0.155591*** (9.113039)
Size		0.014439*** (32.303876)		0.015238*** (13.509948)
Lev		-0.049101*** (-17.538078)		-0.061522*** (-12.059490)
Growth		-0.011061*** (-10.032240)		-0.010394*** (-8.051268)
Board		0.010279*** (3.659124)		0.015409*** (3.251036)
Indep		0.115038*** (11.582230)		0.121356*** (7.246434)
Dual		0.000228 (0.220058)		-0.000597 (-0.357554)
FirmAge		-0.007867*** (-5.944028)		-0.007828** (-2.171163)
Constant	4.312651*** (4,128.890372)	3.964053*** (344.963113)	4.297218*** (2,244.358759)	3.930871*** (131.434515)
Year FE	N	N	Y	Y
Industry FE	N	N	Y	Y
Observations	23,430	23,430	23,429	23,429
r2_a	0.0114	0.103	0.0965	0.183

Notes: The numbers in brackets indicate the t statistic value. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. The sample period is 2011-2021.

#### 4.2. The U-shaped Relationship Test

The quadratic coefficients that are significantly positive have been obtained in the previous section, but based on the quadratic coefficients alone it is not possible to exclude the case where the function is actually concave and monotonic [22]. In order to verify whether the U-shaped relationship in the baseline regression of model 1 really exists, this paper is further verified by UTEST, turning point test and group regression. The t-value in UTEST is 3.83 and the p-value is 0.00008, which disproves the null hypothesis and establishes the existence of the U-shaped connection. Meanwhile, together with the inflection point test in Fig. 1, it shows that the inflection point of the quadratic model in the baseline regression is 7.323083, while the interval of the government subsidy in this paper is from 0 to 23.11, indicating that the threshold falls within the set of government subsidy values, which rules out the possible misleading existence of a one-sided quadratic model only. More specifically, since the minimum value of government subsidies is 0, the connection between them and ESG appears more akin to a “spoon-shaped relationship”, where government subsidies are negatively correlated

with ESG from 0 to the extreme point of 7.323083, which makes up 31.69% of the total interval. After the extreme value of 7.323083 and up to 23.11, ESG increases as government subsidies increase, accounting for 68.31% of the total interval. And the lower bound slope is -0.0018657, while the upper bound slope is 0.0040233. Both slopes are significant at the 1% level of significance.



**Figure 1.** Inflection point test.

### 4.3. Mechanism Test

Based on models 2-4, this paper constructs a mechanism test for the inter-products of the primary and secondary terms of financing constraints, green innovation, political connection, and government subsidies, respectively. The main focus is on the coefficients of the cross-products of the moderating variables and the quadratic term of government subsidies. If the corresponding coefficients are positive, the corresponding moderating variables are positively moderated and vice versa. Table 5 provides the particular regression findings.

Column 1 in Table 5 presents the regression findings from model 2. Indicating that financial constraints have a negative moderating effect on the U-shaped connection between government subsidies and ESG, the coefficient of the quadratic term of financing constraints and government subsidies is significantly negative at the 1% significance level, with the higher the financing constraints, the less significant the U-shaped connection is, and the lower the financing constraints, the more significant the U-shaped connection is. The regression results of model 3 are displayed in column 2 of table 5. The relationship that exists between government subsidies and ESG is negatively moderated by green innovation, demonstrated by the coefficient of the quadratic term between the two, which is significantly negative at the 5% level of significance. In other words, the higher the green innovation, the less significant the relationship between the two is, and the lower the green innovation, the more significant the relationship between the two. The regression outcomes of the model 4 are shown in column 3 of Table 5. Political connection negatively moderates the U-shaped interaction between government subsidies and ESG, which is less significant in the presence of political connection and more significant in the absence of political connection, according to the coefficient of the quadratic term of political connection and government subsidies, which is significantly negative at the 5% level of significance.

**Table 5. Mechanism test**

VARIABLES	(1)	(2)	(3)
	ESG	ESG	ESG
lnSUB	-0.005470*** (-4.389643)	-0.002014*** (-4.139128)	-0.002440*** (-4.037485)
lnSUB2	0.000385*** (5.559311)	0.000137*** (4.565773)	0.000163*** (4.586234)
FC	0.031301*** (4.652135)		
c.FC*c.lnSUB	0.000614*** (2.664097)		
c.FC*c.lnSUB2	-0.000044*** (-3.720420)		
GI		0.000151* (1.739109)	
c.GI*c.lnSUB		0.000023 (1.533179)	
c.GI*c.lnSUB2		-0.000001** (-2.495369)	
PC			0.004821 (1.506934)
c.PC*c.lnSUB			0.001666* (1.788426)
c.PC*c.lnSUB2			-0.000103** (-2.035565)
Control Variables	Y	Y	Y
Year FE	Y	Y	Y
Industry FE	Y	Y	Y
Observations	23,429	23,429	23,429
r2_a	0.185	0.184	0.185

Notes: The numbers in brackets indicate the t statistic value. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. The sample period is 2011-2021.

## 5. ROBUSTNESS TESTS

### 5.1. Change Sample Range and Time

In order to exclude the influence of sample specificity on the results of this paper, we treated the original sample properly. In panel A of Table 6, we exclude the sample of four municipalities in China and re-estimate the quadratic relationship between government subsidies and ESG, columns 1-4 show the coefficients of the quadratic terms of government subsidies, all of which are significantly positive at the 1% significance level. In panel B of Table 6, we narrow the sample time span to 2015-2020 and re-regress the model 1, which shows that government subsidies and ESG still have a significant U-shaped relationship.

**Table 6.** Change sample range and time

Panel A Changing the sample range				
VARIABLES	(1)	(2)	(3)	(4)
	lnESG	lnESG	lnESG	lnESG
lnSUB	-0.004578*** (-12.262704)	-0.001570*** (-4.158201)	-0.004649*** (-7.339742)	-0.002000*** (-3.603163)
lnSUB2	0.000254*** (11.740396)	0.000067*** (3.065737)	0.000332*** (8.585836)	0.000136*** (3.714319)
Observations	18,517	18,517	18,517	18,517
Controls	N	Y	N	Y
Year FE	N	N	Y	Y
Industry FE	N	N	Y	Y
r2_a	0.00801	0.0962	0.0882	0.170
Panel B Changing the time period				
VARIABLES	(1)	(2)	(3)	(4)
	lnESG	lnESG	lnESG	lnESG
lnSUB	-0.004697*** (-10.458388)	-0.000894** (-1.983940)	-0.005973*** (-8.678396)	-0.002418*** (-4.726243)
lnSUB2	0.000260*** (9.863915)	0.000014 (0.536548)	0.000414*** (9.680587)	0.000158*** (4.937894)
Observations	12,893	12,893	12,891	12,891
Controls	N	Y	N	Y
Year FE	N	N	Y	Y
Industry FE	N	N	Y	Y
r2_a	0.00849	0.105	0.0966	0.184

Notes: The numbers in brackets indicate the t statistic value. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. The panel A sample period is 2011-2021 and the panel B sample period is 2015-2020.

## 5.2. Shrinkage Treatment

Table 7 provides results from shrink treatment to the sample. After shrinking the sample at both ends at the 1 % level, columns 1-4 show that the coefficient on the quadratic term of government subsidies remains significant at the 1% significance level, further validating the robustness of the U-shaped relationship between government subsidies and ESG.

**Table 7.** Shrinkage treatment

VARIABLES	(1)	(2)	(3)	(4)
	lnESG	lnESG	lnESG	lnESG
lnSUB	-0.005246*** (-16.485036)	-0.001195*** (-3.641385)	-0.005415*** (-10.276637)	-0.001866*** (-3.829930)
lnSUB2	0.000297*** (16.339512)	0.000045** (2.354853)	0.000385*** (11.907577)	0.000127*** (4.214330)
Controls	N	Y	N	Y
Year FE	N	N	Y	Y
Industry FE	N	N	Y	Y
Observations	23,430	23,430	23,429	23,429
r2_a	0.0114	0.103	0.0965	0.183

Notes: The numbers in brackets indicate the t statistic value. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. The sample period is 2011-2021.

### 5.3. Lagged Dependent Variable

Table 8 provides results from lagging dependent variable. Columns 1-2 show that the coefficient on the government subsidy quadratic term remains significantly positive at the 1 % level of significance after one lag of the government subsidy. Similarly, Columns 3-4 show that the coefficient on the quadratic term of government subsidies remains significantly positive at the 1 % level of significance after two lags of government subsidies. The robustness of the U-shaped relationship between government subsidies and ESG is further examined.

**Table 8.** Lagged dependent variable

VARIABLES	(1)	(2)	(3)	(4)
	lnESG	lnESG	lnESG	lnESG
L.lnSUB	-0.006456*** (-10.410352)	-0.002391*** (-4.325211)		
L.lnSUB2	0.000448*** (12.308704)	0.000159*** (4.892288)		
L2.lnSUB			-0.006539*** (-8.400763)	-0.001770** (-2.550709)
L2.lnSUB2			0.000459*** (10.596187)	0.000123*** (3.221927)
Observations	19,317	19,317	16,433	16,433
Controls	N	Y	N	Y
Year FE	N	Y	N	Y
Industry FE	N	Y	N	Y
r <sup>2</sup> _a	0.105	0.188	0.105	0.193

Notes: The numbers in brackets indicate the t statistic value. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level, respectively. The sample period is 2011-2021.

## 6. CONCLUSIONS AND POLICY IMPLICATIONS

This study collects panel data to examine how government subsidies affect corporation ESG scores and its mechanism of action, using Chinese A-share main board listed companies from 2011 to 2020 as the research sample. The findings indicate that: (1) Government subsidies and corporate ESG share a strong U-shaped nonlinear connection; (2) Financing constraints, green innovation, and political affiliation moderate the relationship.

The connection between government subsidies and corporate ESG scores tested in this paper can further improve the theory and methodology of corporate sustainability and green finance. First, by focusing on firm-level government subsidies from a micro perspective rather than total macro government subsidy expenditures, this study reveals a nonlinear U-shape connection between government subsidies and ESG scores, showing how they initially hinder and later boost them, providing a new perspective on the study of government subsidies and ESG. Second, this paper identifies three moderating effects of financing constraints, green innovation, and political affiliation on the effect, enriching relevant research on ESG impact mechanisms. Finally, this paper argues that improving ESG scores and increasing corporate social responsibility is not an overnight process, but rather a deliberate undertaking that calls for the cooperation of both governmental and commercial

actors. New reflections are provided on the current development of green finance in China and the formulation of subsidy policies to meet the dual-carbon target:

Government subsidies and business ESG ratings have a U-shaped connection, so as to lessen the effect of low subsidies crowding out businesses' green practices, the government should reconsider the allocation of resources according to different regions, sizes, and types of enterprises' property rights, and provide sufficient support to enterprises that really need subsidies to promote green behaviors and motivate them to fulfill their corporate social responsibility, engage in green production, and provide green services. Before providing subsidies to enterprises, it is important to fully understand their operational information and management information to avoid unnecessary financial losses. Second, government agencies should improve their oversight regarding how businesses spend subsidy money, so that the subsidy funds can be truly used for the purpose of subsidies, and actively guide enterprises to make full disclosure on the use of their subsidies, so as to build an open, transparent and complete "subsidy use-re-subsidy" virtuous cycle. First, the sample data in this study are primarily from Chinese A-share listed businesses, and there is no discussion and analysis on non-listed enterprises and enterprises in other countries, and future research can expand the sample scope and conduct comparative studies on other countries and more enterprises. Second, this research solely looked at how government subsidies affected business ESG, while business ESG may be influenced by management culture, green preferences and personal experiences, etc. Future research can further investigate the impact of executives' personal characteristics on ESG.

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