Green Innovation (GI)

Subjects: Green & Sustainable Science & Technology

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Green innovation (GI) is an essential measure to realize green growth. The value of GI on achieving sustainable development goals is increasingly recognized in recent years. Promoting GI is also the fundamental requirement of China's 14th Five-Year Plan. Notwithstanding that the central government has put the sustainable development goals at the heart of policy-making, formulating several environmental policies, the overall efficiency of environmental governance does not meet expectations. The GI of manufacturing industries is insufficient, and the phenomenon of illegally discharging pollutants continues to repeat, making the effects of policies into question.

Keywords: environmental governance ; green innovation ; regulatory capture

1. The Development of Regulatory Capture Theory

Downs [1] gives the foundation of the modern "capture" theory of political behavior. In Downs's view, private interests are willing to put regulations into effect by persuasion, campaign contributions, or other political action to benefit their interests. Stigler [2] claims that although a policy is set up to prevent monopoly, the economic interest may use the public resources and powers by providing officials with political votes and bribery to benefit their economic status. And Posner [3] claims that even though the priority of the policy formulation is for public interests, due to the influence of regulated interests, the policy ends up being 'captured' by private interests it should discipline.

Peltzman is not satisfied with Stigler's conclusion that the regulatory agencies only serve a single economic interest. Based on Stigler's idea, Peltzman [4] incorporates multiple interest groups into the regulatory decision model and shows the effect of the supply-demand relationship between producers and consumers on regulatory behavior, indicating that regulatory behaviors are often affected by interactions among multiple interest groups. Notwithstanding the introduction of multiple interests theory makes the research on regulation capture breakthrough the quantitative limit of a single subject, it is hard to explain the phenomenon of collective regulation capture in real life. Also, multiple interest theory ignores informational asymmetries.

Laffont and Tirole [5] consider the informational asymmetries, bring the demand and the supply side together, and develop an agency-theoretic approach. Laffont points out that the regulatory structure is two-tiered: agency (the supervisor) and Congress (the principle). There exist informational asymmetries between the principal (Congress) and the supervisor (agency). The agency can obtain the information from the enterprises and report to Congress. Therefore, interest groups can collude with the agency to retain specific kinds of information. In this case, the agency may conceal information for personal gains and only report the information beneficial to the enterprises to Congress, thus forming collective regulation captures. The framework of "regulatory authority-the agency-multiple interest groups" makes the theory of regulatory capture breakthroughs in the limits of organizational boundaries, and to a certain extent, provides theoretical guidance for the practice of weakening of the regulatory capture in Western countries in the last century.

2. The Affecting Factors of Regulatory Capture

Local governments generally have policy burdens such as promoting economic development and maintaining employment rates [6]. When manufacturing companies do not carry out GI and violate environmental regulations to discharge pollution, as long as manufacturing enterprises' revenue is highly related to the local economy and employment, they can use policy burdens they undertake to intervene in the regulatory process, making it difficult for local governments to impose strict penalties on enterprises and even provide cover and shelter for them [7]. Shen et al. [8] use the instrumental variable method to examine the effect of central government's behaviors of setting economic development goals on the regional GI, indicating that the economic development goals have significant inhibitory effects on regional green technology innovation, and the inhibitory effect is more prominent in cities with faster economic growth and over-fulfillment of economic development goals. As a result, environmental problems are getting worse, and the development of GI is hindered.

The negative effect of policy burdens on regulatory capture not only occurs in environmental governance but also in other fields. We take state-owned enterprises as an example. KORNAI* [9] proposes a concept called “soft budget constraint” when analyzing the socialist economy and thinks soft budget constraints will bring about many problems in the economy, such as the moral hazard of managers, which cause the operation inefficiency of enterprises. Since state-owned enterprises undertake policy burdens such as protecting industries, maintaining social stability, and stimulating economic development, the government has to rescue loss-making state-owned enterprises by increasing financial subsidies, giving loans support, reducing taxes, and so on [6].

The central government of China has found out the built-in “environmentally unfriendly” policy burdens in the cadre performance system and promulgated environmental regulations such as the “Leading Officials’ Accountability Audit of Natural Resource” and incorporated the environmental performance into the performance evaluation of local officials. However, the overall policy efficiency needs to be improved. Feng et al. [10] explore the relationship of Accountability Audit of Natural Resource and political promotion in China and show that to some extent, the accountability can decrease the dependence on the traditional “political tournament mechanism”. Wu and Cao [11] show the link between pollution control and the promotion of officials, but this kind of link only exists at the county level, not at the municipal and provincial level.

Scholars also indicate that the external supervisory agency, such as media, can restrain regulatory capture [12][13][14][15]. Laffont and Meleu [12] study the reciprocal supervision in an institution with one principal and two agents. This study shows that the information exchange between two agents may hurt the principal, and such a dual supervisory structure enhances the possibility of collusion, indicating that the principal should have a third party be the supervisor to avoid regulatory capture. Fremeth and Holburn [13] propose that the information asymmetries between regulators and enterprises increase the costs of setting up new policies, and information asymmetry can be reduced through previous regulatory experience, knowledge gained from interest groups, or information from other supervisory institutions. Gong et al. [14] suggest allowing and protecting media reports and encouraging the establishment of private supervision institutions can reduce the asymmetry of information. Gao et al. [15] indicate the positive effect of media in promoting government information disclosure in environmental accidents. Grafton and Williams [16] show that the evidence of regulatory capture in the Murray-Darling Basin stems from a 2017 media investigation of water theft in the northern Murray-Darling Basin.

3. The Affecting Factors of GI

GI is a process that contributes to the creation of new products and technologies intending to reduce environmental degradation [17], and GI includes innovation in energy conservation, pollution prevention, waste recycling, green product design, and environmental management [18]. Many scholars have evaluated the affecting factors of GI. From the perspective of enterprises, green R&D expenditure [19][20], top management [21][22][23][24][25], organizational culture and employee [25][26][27], corporate profitability [28], and knowledge sharing [29][30][31] are main factors which affect the GI. From the perspective of market, market demands [24][32], the demand of customers and the stakeholders [24][28][33], and market competition [20][24][34] are main factors affecting GI. From the perspective of government, government support [35][36], environmental regulations [37][38][39][40][41] and policy burdens [8] are the main factors that affect the outcome of GI.

The government’s strong macro-control capabilities of China are extremely effective in promoting GI [35][40]. Thus, this study mainly focuses on the perspective of government. Many scholars prove that environmental regulation positively affects GI [37][38][40]. However, sometimes environmental regulations are inefficient and even inhibiting the occurrence of GI [42][39][41]. The regulatory capture theory shows that due to the government’s multiple goals and official’ personal incentives, the regulated enterprises may influence the regulatory agency and officials through bribery and other methods and ultimately lead to inefficiency of the regulation [2][3]. Therefore, based on the regulatory capture theory, research on restraining regulatory capture and improving the efficiency of environmental governance is of great significance to promote GI.

4. Evolutionary Game Theory in Environmental Governance

Evolutionary game theory is an effective tool for modeling decision-making process [43], providing a mathematical solution to the conflict and cooperation of stakeholders [44][45]. Besides, evolutionary game theory considers the bounded rationality of stakeholders [46] and the dynamics of the decision-making process [47], which is conducive for analyzing the evolutionary mechanism of decision-making related to environmental governance.

Many researchers have used the evolutionary game theory to study the decision-making process of the government and enterprises in environmental governance. Wang et al. [48] establish an evolutionary game model to analyze the decision-making process between the government that manages environmental pollution and the firm that generates contamination and suggest using a dynamic penalty to control the environmental pollution. Zhang et al. [49] construct an evolutionary

game model to analyze the impacts of government policies on manufacturers' choices of green innovation mode, declaring carbon tax and innovation subsidy may facilitate radical innovation. Similarly, Zhao and Bai [50] adopt evolutionary game theory to investigate the effect of different government policies on motivating the producers' green innovation. Sheng et al. [51] employ evolutionary game theory to analyze the strategical choices among the central government, local governments, and enterprises under different environmental regulations. Moreover, this study claims that increased default penalties and compliance incentives are the most effective for environmental governance. However, these studies consider the government as the only supervisor of environmental governance.

Further, Gao et al. [15] examine the role of social media on information disclosure of environmental incidents through evolutionary game theory. The results indicate that social media can affect information disclosure of environmental incidents through top-down intervention and bottom-up reputation mechanisms. Chen et al. [52] use evolutionary game theory to model the relationship among government, enterprise, and the public in environmental governance and prove public participation significantly promotes the control of industrial wastes. The authors of Xu et al. [53] build the tripartite evolutionary game model to explore the strategical choices among governments, environmental services companies, and pollutant discharging enterprises. The results show that the "public-private-partnership" governance system and administrative penalties are the key points to the governance of environmental pollution. However, these studies all tacitly assume that the government can effectively implement environmental policies and promote GI. The scenarios where government policies fail due to regulatory capture have not yet been discussed. Further, the role of policy burdens in regulatory capture is not verified.

5. Toward and Analytical Framework

In the process of environmental governance, regulatory capture between local governments and manufacturing enterprises will influence their willingness to solve environmental problems. To fix this issue, restraining regulatory capture and promoting GI through systematic studies is urgent for achieving sustainable development goals.

To sum up, previous studies theoretically analyzed the impact of policy burdens on regulatory capture and the connection between regulatory capture and GI. Multiple studies also show that the external supervisory agency, such as the media, can participate in the supervisory process of environmental governance and deal with the information asymmetry between the public and the government, thereby decreasing the negative effect of policy burdens and restraining regulatory capture. However, it is still necessary to verify the impacts of policy burdens and media on the decision-making process of local governments and manufacturing enterprises.

Based on existing research, the paper uses evolutionary game theory to explore how the policy burdens and media reshape the decision-making between local governments and manufacturing enterprises in environmental governance. Then, this study has revealed the behavioral change between local governments and manufacturing enterprises through numerical simulation. Besides, we have discussed the difference between the impacts of policy burdens and media on environmental behaviors. Ultimately, combined with the different development stages of China's green industry, the corresponding policy recommendations are given.

As shown in **Figure 1**, the process of environmental governance includes the following main bodies: central government, local government, manufacturing enterprises, and media. Central government formulates environmental policies, economic growth targets, and employment rate targets. The local government undertakes policy burdens, implements environmental policies, and supervises the environmental behaviors of manufacturing enterprises. Manufacturing enterprises undertake tasks of providing jobs, paying taxes, and implementing green innovations. The media is responsible for supervising the decision-making process and exposing information to the public and central government.

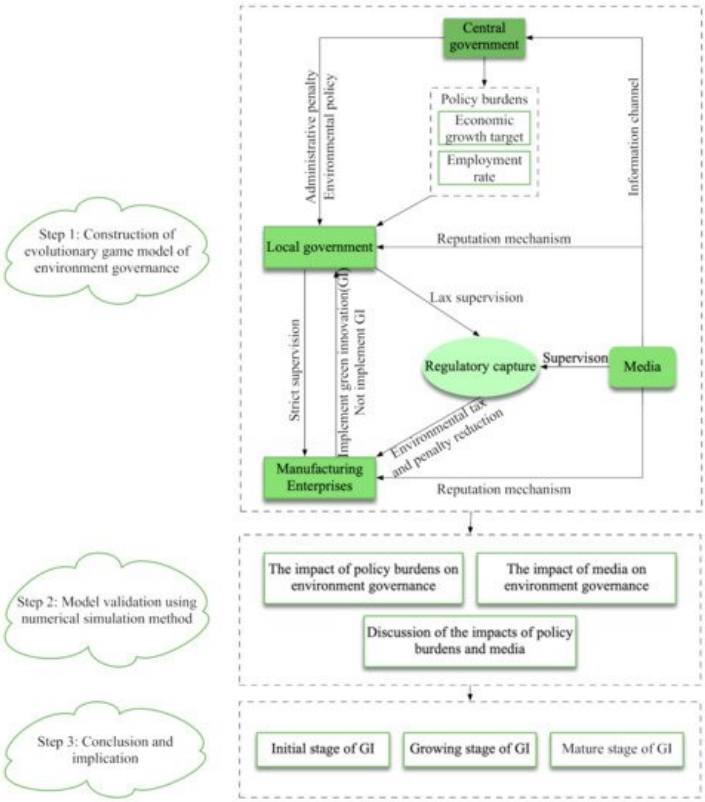

Figure 1. Analytic framework.

Manufacturing enterprises choose to implement GI or not implement GI. The local government decides to strictly supervise manufacturing or lax supervision. The decision of lax supervision represents that due to policy burdens, the implementation of environmental policies has been affected, resulting in regulatory capture. The local economy and employment are highly dependent on manufacturing enterprises. Implementing GI requires a lot of R&D investment, and the return of green innovation is lagging, which will affect the company's operations and revenues in the short term. As a result, the regional economy and employment rate will suffer losses. The authors of Cherry et al. [54] find that public opposition to the efficiency-enhancing environmental tax is a significant barrier to addressing environmental challenges. Thus, as the primary supervisor of environmental governance, the local government should support the R&D of GI by environmental tax deduction. Besides, as the main implementer of environmental governance, manufacturing enterprises can implement GI to get a competitive advantage, achieving long-term development [34].

At the same time, the media can participate in environmental governance in two ways. First, the media participates in the environmental governance by reputation mechanism [15]. The reputation mechanism of media is that the media can realize its supervisory function by influencing the reputation of governments, enterprises, or individuals [55]. Second, media will act as an information channel of the central government, expose information to the central government and introduce administrative penalties from the central government [15]. In particular, the media judges whether regulatory capture exists by checking local environmental improvement and the application and authorization of green patents for manufacturing enterprises. Therefore, only when manufacturing enterprises choose not to implement GI, the media has a chance to find regulatory capture.

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