Conflict analysis and coordination mechanism of ESG Information Disclosure Based on GMCR under the background of double carbon target

Yang Fu*, Qipei Feng, Yunfei Xie, Sainan Zhu

College of Economlcs and Management, Nanjing University of Aeronautics and Astronautics, Nanjing, China

*Corresponding author: young3688@nuaa.edu.com

Abstract. In recent years, with the promotion of carbon peak and neutrality policy, the issue of environmental, social and governance (ESG) information disclosure has become a hot topic of common concern to all sectors of society. Through the study of the conflict mechanism in ESG information disclosure, it can help decision makers choose a solution which can be accepted by others and help them develop. By implementing the Graph Model for Conflict Resolution (GMCR), we construct a conflict model for governments, enterprises, financial institutions and investors in the ESG information disclosure. GMCR can conduct stability analysis based on their preferences, and reach equilibrium results so as to provide a worthy reference plan for multiple parties and build a coordinated development mechanism in which they can rely on and promote each other.

Keywords: graph model for conflict resolution, ESG information disclosure, Stability analysis, coordinated mechanism.

1. Introduction

Climate problem is a common challenge faced by all mankind. The consequences of extreme weather and environmental degradation are deeply affecting all aspects of human production and life. In order to ensure the sustainable development of human society, how to promote low-carbon emission reduction and cleaner production has become the focus of attention all over the world, and the concept of "double carbon" came into being.

Under the "double carbon" goal, how should Chinese enterprises give full play to their subjective initiative and formulate long-term sustainable development strategies, which are in line with the national development theme of energy conservation, environmental protection and green sustainability; What indicators should financial institutions and individual investors use to identify climate risks and social risks in the investment process, so as to actively practice low-carbon emission reduction investment activities and give full play to the financial market's support for carbon neutral economy is still a problem to be solved. This calls for the emergence of a non-financial information disclosure system, which can make an objective and scientific evaluation of enterprise performance and information disclosure from the level of social responsibility. In the process of investing in enterprises, the investment concept of ESG (environment, society and governance) has gradually attracted the attention of investors because it takes into account the traditional corporate evaluation indicators and the impact of enterprises on the environment. ESG information has also been considered by enterprises to be included in the scope of disclosure to the society.

As a key subject in the capital market, how will enterprises disclose ESG information, how will investors' investment decisions be affected by ESG information disclosure, what is the attitude of the government towards ESG information disclosure, how financial institutions respond to enterprise ESG information disclosure, how the behaviors of the four parties interact and restrict each other, how to analyze the action mechanism and find the equilibrium state in the conflict, so as to make the healthy development of ESG ecosystem, It is a proposition worthy of in-depth study.

2. Conflict analysis graph model theory

Graph model for conflict resolution (GMCR) [1] is a decision-making method for formal analysis of conflict behavior based on game theory and developed on classical game theory and metagame theory. It was originally created by Kilgour and hipel and fully described by Fang et al. Since then, it has been widely used in environmental governance, resource allocation, war conflict and trade negotiation.

In game theory, quantitative methods are mostly used to analyze and solve problems, while in the application process, a large number of accurate data are needed as support, which limits its application; However, the graph model comprehensively considers multi-party decision makers and their behavior changes, makes maximum use of a small number of decision makers' relative preferences as basic information [2], carries out modeling and logical analysis, and provides multi-party satisfactory scientific decision-making schemes for decision makers. This theory is between quantitative and qualitative. The decision analysis method has a wider application range, more timely and flexible use.

The conflict analysis diagram model is represented by $V = \{N, S, P, G\}$. Where $N(N \geq 2)$ represents a finite non empty set containing all decision makers; $S = \{s_1, s_2, \cdots, s_m\}$ represents a non-empty set of all feasible states; $P = (\{\succ_i, \sim_i\})$ represents the preference information of decision makers; G represents the state transition diagram of the decision maker [3].

Conflict analysis mainly includes the following three stages: modeling stage, analysis stage and decision-making stage. In the modeling stage, it is required to find out the decision-makers and their possible behavior strategies in the conflict problem, and determine their preferences according to their state development design, which includes the three constituent elements of conflict analysis, and the preference information of multiple decision-makers, strategies and participants in the conflict process. Decision makers can be individuals, institutions, governments and other individuals or groups that can make independent decisions, and have clear interest demands in the conflict system; Strategy refers to the way that the decision-making can choose to take or not take various actions according to the problems faced; Preferences are the advantages and disadvantages of states obtained by decision makers according to their expected goals and their own judgment of conflict.

In the analysis stage, we conduct stability analysis to make the graph model reach the equilibrium state. Stability [4] means that if all decision makers reach stability at a certain state point, the state point is said to be an equilibrium point and the solution of conflict analysis. At present, in conflict analysis, the concept of basic stability clearly reflects the four behavioral characteristics of decision-makers, namely, the absolute rationality of decision-makers under Nash[5] stability, the conservatism of decision-makers under GMR[6] stability and SMR[6] stability, and the risk-taking of decision-makers under SEQ[7] stability.

3. Establish conflict model

2.1 Assumptions about decision makers

Decision maker (DM) in conflict refers to the player or community of interests with certain decision-making power. Through the analysis of the development status and existing problems of ESG information disclosure, this paper will take ESG information disclosure as the core conflict, and define the government (DM1), enterprises (DM2), financial institutions (DM3) and investors (DM4) as the decision makers of the conflict.

Assumptions: (1) enterprises need to pay a large and non negligible cost to improve ESG score; (2) The government and financial institutions have always maintained the attitude of promoting ESG information disclosure under the current situation, and there is no resistance;

2.2 Decision maker behavior

Government (DM1), the government (including legislature and supervision organization) is the organ of social management of the state, which is mainly responsible for the formulation of regulations and policies and the supervision of the implementation of regulations and policies. Therefore, the government's attitude towards ESG will largely determine the implementation and development of ESG. If the government effectively organizes and guides public relations, the attitude of enterprises towards ESG will also be affected by the tendency of the government. In addition, the same government may adopt different attitudes towards specific issues in E, S and G. The specific strategies are as follows:

Encouragement: the government implements policies and regulations with the nature of encouragement and calls on enterprises to consciously disclose ESG information to the public. This requirement largely depends on the voluntary participation of enterprises and does not impose sufficient binding force on enterprises. Under the premise of no mandatory requirements, ESG information disclosure shall be actively carried out in accordance with the information disclosure framework developed by non-governmental organizations (Global Reporting Initiative gri, carbon disclosure Committee CDSB) or exchanges.

Mandatory: mandatory ESG information disclosure means that governments or financial regulators require enterprises to disclose ESG related information through clear laws, regulations or management measures. Countries' requirements for mandatory disclosure are roughly divided into three categories: the first category requires all listed companies to disclose ESG information, such as the United States and South Africa; The second category requires listed companies that meet certain conditions to disclose ESG information. For example, India requires listed companies with top 100 assets to disclose ESG information; The third category requires listed companies to "explain ESG information without disclosure", such as Brazil and Singapore. At the macro level, more and more governments have or are bringing ESG issues into the scope of legislation and supervision.

Enterprise (DM2), as the basic unit of the national economy, is the main participant in market economic activities and the main body of practicing ESG information disclosure. On some specific ESG issues, it can effectively make up for the limitations of the role of the government. For example, on climate issues, compared with a single strategy at the national level, the participation and action of enterprises will be the core elements of solving climate change problems.

Radical disclosure: in the process of ESG information disclosure, enterprises take a positive attitude of cooperation and eagerly hope to make fundamental, rapid and immediate changes to the ESG information disclosure system.

Progressive disclosure: in the process of ESG information disclosure, enterprises tend to present slowly and gradually, follow the principle of "from abstract to concrete", divide the selection or information into several parts, and display the ESG information of enterprises in a more comfortable and pleasant way.

As the core of modern economy, financial institution (DM3) is the hub linking micro enterprises, individual subjects and macro superstructure. It is an organization specializing in financial activities and an important action subject of ESG information disclosure. It not only directly affects the process of economic construction, but also relates to the situation of social development to a certain extent, which requires financial institutions to bear certain social responsibilities while supporting the economic foundation. Therefore, how financial institutions practice ESG concept and strengthen ESG information disclosure will become the key to the sustainable development of economy and society in the future.

Advocacy: financial institutions use capital to guide enterprises to consciously disclose ESG information, so as to achieve a situation in which enterprises and society work together for good and benefit.

Mandatory: financial institutions formulate a unified standard scheme to bring ESG information disclosure into the scope of mandatory supervision of the financial industry. The Directive requires qualified enterprises to regularly disclose information related to environmental and social issues. For example, France explicitly requires listed companies to disclose the financial risks caused by climate change and the measures taken to reduce financial risks in their annual reports; And the impact of climate change on the company's operations, products and services.

Investors (DM4) realize the growth of wealth by allocating and mobilizing the ability of social resources, which is an important part of promoting the completion of ESG ecosystem. More investors understand the meaning and value of ESG concept, which will help promote the development of ESG investment in China.

Tendency: with the prevalence of ESG investment concept, investors take more initiative to consider ESG information factors into the scope of investment in order to make long-term profits rather than temporary profits, analyze enterprise financial performance in combination with enterprise environmental performance, and participate in investment more actively.

2.3 Feasible state set

Conflict analysis requires that each decision-maker, that is, multiple subjects, have the ability to make decisions independently. In the issue of ESG information disclosure, each subject can make choices that meet the decision-maker based on the external environment, and all state points are formed by the arrangement and combination of the choices of each subject in ESG information disclosure. According to mathematical logic, each strategy has two choices: Yes or no, so theoretically there are $2^8 = 256$ state points. However, in the actual performance process, there are logical infeasible states. For example, DM1 must choose one of the two strategies of "advocacy" and "enforcement", and can only choose one at most, and the rest are the same. After excluding the logical infeasible States and merging the states with the same outcome, there are 16 feasible states.

Table 1 feasible state set of ESG information disclosure conflict

DMs	DM1		DM2		DM3		DM4
	government		enterprise		financial institution		investor
options	encourage	rigid	Radical disclosure	Progressive disclosure	Advocate	force	inclination
S_1	N	Y	N	N	N	Y	N
S_2	N	Y	N	N	N	Y	Y
S_3	N	Y	N	N	Y	N	N
S_4	N	Y	N	N	Y	N	Y
S_5	N	Y	N	Y	N	Y	N
S_6	N	Y	N	Y	N	Y	Y
S_7	N	Y	N	Y	Y	N	N
S_8	N	Y	N	Y	Y	N	Y
S_9	N	Y	Y	N	N	Y	N
S_{10}	N	Y	Y	N	N	Y	Y
S_{11}	N	Y	Y	N	Y	N	N
S_{12}	N	Y	Y	N	Y	N	Y
S_{13}	Y	N	N	N	N	Y	N
S_{14}	Y	N	N	N	N	Y	Y
S_{15}	Y	N	N	N	Y	N	N
S_{16}	Y	N	N	N	Y	N	Y
S_{17}	Y	N	N	Y	N	Y	N
S_{18}	Y	N	N	Y	N	Y	Y
S_{19}	Y	N	N	Y	Y	N	N
S_{20}	Y	N	N	Y	Y	N	Y
S_{21}	Y	N	Y	N	N	Y	N
S_{22}	Y	N	Y	N	N	Y	Y
S_{23}	Y	N	Y	N	Y	N	N
S_{24}	Y	N	Y	N	Y	N	Y

2.4 State transition diagram

Draw a state transition diagram according to the above feasible state table, as shown in Figure 1, which specifically describes the direction and process of the states of the four decision makers. The circle indicates the feasible state point, the arrow direction indicates the transition from the initial state to the reachable state, the double arrow indicates that the states can be transformed with each other, and the single arrow indicates that the transformation direction between States is single and irreversible. For example, DM1 in Figure 1, when the state is transferred from S1 to S9, it indicates that the government has changed its attitude from "advocacy" to "coercion", and the decisions of other subjects remain unchanged for the time being, At the same time, this decision will continue to lead to changes in the strategies of other decision makers, which will lead to the continuous transfer of state points.

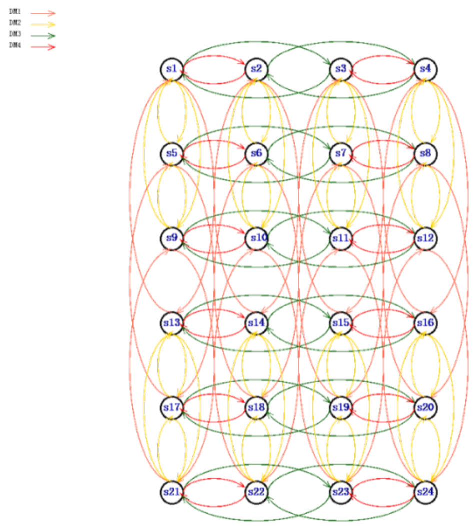

Figure 1: state transition diagram

2.5 Preference information

According to ESG, in the process of information disclosure conflict, each decision-maker obtains the following strategies and instructions from the consideration of their own interests and external environment. At the same time, each decision-maker has different preferences for each strategy, and the strategy priority method is used to rank the preferences of decision-makers.

Table 2 DM1, DM2, DM3, DM4 preference statement and explanation

decision maker	Policy statement	interpretative statement
DM1 Government (legislature, regulator)	1	The government hopes to issue encouraging documents to urge the development of ESG information disclosure industry through encouraging means.
	2IF(-3&-4)	The government hopes to issue policies and regulations to urge enterprises that do not choose gradual disclosure and radical disclosure to disclose ESG information through rigid means
	3IF(1|6)	The government hopes that when it issues incentive documents to support the development of ESG information disclosure industry or financial institutions force enterprises to disclose ESG information, enterprises can choose radical ESG information disclosure.
	7	The government hopes that investors can take the initiative to consider ESG information factors into the scope of investment and promote the development of ESG information disclosure industry.
	6	The government hopes that financial institutions can issue mandatory rules to restrict enterprise ESG information disclosure and promote the development of ESG information disclosure industry.

DM2Enterprise (listed company)	-3|-4	Enterprises do not want radical disclosure or gradual disclosure, and prefer not to disclose ESG information
	4IF(1|5|7)	When the government issues incentive documents to support the development of ESG information disclosure industry, or financial institutions advocate ESG information disclosure, or investors choose to take ESG information into account, enterprises prefer to gradually disclose ESG information
	3IF(2|6)	When the government issues rigid means to urge information disclosure or financial institutions force ESG information disclosure, enterprises prefer radical disclosure of ESG information
	-7	Enterprises do not want investors to pay attention to ESG information disclosure and bring ESG factors into the scope of investment
DM3 Exchanges and financial institutions	6IF2	When the government issues rigid means to urge information disclosure, financial institutions tend to issue mandatory rules to restrict enterprises from ESG information disclosure.
	3	Financial institutions hope that enterprises can gradually disclose ESG information and give play to the role of ESG information disclosure industry
	1|-2	Financial institutions hope that the government can issue incentive documents to urge the development of ESG information disclosure industry or take soft measures to encourage enterprises to publish ESG information
	4IF(1|5)	Financial institutions hope that when the government issues incentive documents or financial institutions advocate ESG information disclosure, enterprises can gradually disclose ESG information
	7	Financial institutions hope that investors can actively pay attention to the development of ESG information disclosure industry and take ESG information into consideration
DM4 investor	7	Investors are more inclined to actively pay attention to the development of ESG information disclosure industry and take enterprise ESG information factors into account
	3IF(2|6)	Investors hope that enterprises will choose radical disclosure of ESG information when the government uses rigid means to restrict ESG information disclosure industries or financial institutions force enterprises to disclose ESG information. Facilitate investors to make correct decisions
	4	Investors hope that enterprises will gradually disclose information, so as to facilitate investors to make better investment decisions under ESG information factors
	2IF(-3|-4)	Investors hope that the government can take tough measures to restrict ESG information disclosure when enterprises do not choose radical information disclosure or progressive disclosure.
	5|6	Investors hope that financial institutions can advocate the development of ESG information disclosure or adopt mandatory rules to restrict enterprise ESG information disclosure, so as to facilitate investment and make better investment decisions.

Through the above preference information, the preference ranking of each decision-maker is obtained, as shown in Table 1.

Table 3 preference ranking of decision makers

DMS	Preference ranking
DM1	S22>S24>S21>S23>S18>S20>S17>S19>S14>S16>S13>S15>S10>S4=S8=S12=S9>S3=S7=S11=S2=S6>S1=S5
DM2	S9=S19>S20>S1=S5=S7=S17>S6=S8=S18>S11=S15=S21=S23>S10=S12=S16=S22=S3=S13>S2=S4=S14
DM3	S22=S24>S21=S23>S10>S9>S18=S20>S17=S19>S14=S16>S13=S15>S2=S6>S1=S5>S12>S11>S8>S7>S4>S3

DM4	S20>S10=S12>S16=S22=S24>S6=S8>S18>S2=S4>S14>S19>S9=S11>S15=S21=S23>S5=S7>S17>S1=S3>S13

It can be seen that for DM1 government, S_{22} is its ideal state. In this state, the government adopts the attitude of encouragement and support. Financial institutions indicate that enterprises must disclose more ESG information in order to gain more advantages in the market. At this time, enterprises can only take radical measures to publish the company's ESG information to the public as much as possible according to the requirements of financial institutions and trading houses, To meet the favor of investors for companies with more ESG information disclosure

For DM2 enterprises, S9 and S19 are the best ranking. In this state, whether investors prefer companies with more ESG information disclosure or not, if the government and financial institutions adopt mandatory policies at the same time, the enterprises must carry out complete and accurate information disclosure. If the government adopts encouraging policies and measures, financial institutions also adopt gradual reform, Then the enterprise will make internal adjustment while producing and operating, and gradually disclose ESG information instead of not disclosing it.

For DM3 financial institutions, S22 and S24 are the best preferences. If facing the market choice of investment, companies tend to disclose more ESG information and higher ESG score, and enterprises can consciously complete the company's ESG information disclosure, the government can continue to adopt soft policies and measures. At this time, financial institutions can take mandatory measures or keep pace with the government.

For DM4 investors, S20 is the optimal solution. Investors themselves tend to obtain more relevant information of the company, so as to strengthen the confidence of investors. In the face of the attitude of investors, the government and financial institutions actively advocate ESG information disclosure. The company will also take into account the choices of investors, consider the cost of production and operation itself, and choose to gradually cater to the preferences of investors.

4. Stability analysis

By solving the preference information of the above decision-makers, the stability state of each decision-maker under each feasible state point is obtained, where "√" indicates that DMS is balanced under the corresponding stability under the feasible state, and "□" indicates that the state point is the equilibrium solution.

Table 4 stability analysis

state	Nash					GMR					SMR					SEQ				
	DM1	DM2	DM3	DM4	Eq	DM1	DM2	DM3	DM4	Eq	DM1	DM2	DM3	DM4	Eq	DM1	DM2	DM3	DM4	Eq
S_1			√				√	√				√	√				√	√		
S_2			√	√				√	√				√	√				√	√	
S_3																				
S_4				√					√					√					√	
S_5			√				√	√				√	√				√	√		
S_6		√	√	√			√	√	√			√	√	√			√	√	√	
S_7		√					√					√					√			

S_8		√		√			√		√			√		√			√		√	
S_9		√	√				√	√				√	√				√	√		
S_{10}			√	√				√	√				√	√				√	√	
S_{11}																				
S_{12}				√					√					√					√	
S_{13}	√		√			√		√			√		√			√		√		
S_{14}	√		√	√		√		√	√		√		√	√		√		√	√	
S_{15}	√		√			√		√			√		√			√		√		
S_{16}	√		√	√		√		√	√		√		√	√		√		√	√	
S_{17}	√	√	√			√	√	√			√	√	√			√	√	√		
S_{18}	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
S_{19}	√	√	√			√	√	√			√	√	√			√	√	√		
S_{20}	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
S_{21}	√		√			√		√			√		√			√		√		
S_{22}	√		√	√		√		√	√		√		√	√		√		√	√	
S_{23}	√		√			√		√			√		√			√		√		
S_{24}	√		√	√		√		√	√		√		√	√		√		√	√	

It can be seen from the table that S18 and S20 are the equilibrium solutions of the conflict problem under the definitions of Nash, GMR, SMR and SEQ.

The government implements encouraging policies and regulations, calls on enterprises to consciously disclose ESG information to the public, relies on the voluntary participation of enterprises, and does not impose mandatory binding force on enterprises. Investors are increasingly inclined to enterprises with complete ESG information disclosure. At the same time, financial institutions continue to take mandatory measures in cooperation with companies according to policy guidance and market choice, so that enterprises can disclose ESG information as much as possible, Therefore, S18 is not a multi-party satisfactory equilibrium solution; However, if financial institutions keep in line with the guidance of the government and adopt persuasive means of urging and considering long-term development, then enterprises need to adopt a cooperative attitude and gradually adjust the company's business development and internal structure. Therefore, S20 is the consistent equilibrium solution of all parties.

5. Coordination mechanism

As a highly complex system, ESG information disclosure mechanism itself involves the interests of the government, enterprises, financial institutions, investors and other parties. In order to truly build an effective disclosure system that comprehensively considers the interests of multiple parties, and make the information disclosure from disorder to order, from confrontation to cooperation and from other organizations to self-organization, it is naturally inseparable from the coordination and cooperation of all parties.

In order to help ESG information disclosure, multiple subjects need to build a unified disclosure framework and standards. The principles of system openness, order parameters and self-organization in synergy theory can provide theoretical support. By analyzing the problems existing in ESG information disclosure with the help of synergy theory, it can be found that synergy is the inevitable requirement of establishing and perfecting a unified ESG disclosure framework and standard; Order parameter is the main contradiction in the establishment of ESG information disclosure standard; Self organization is the fundamental way to improve ESG information disclosure standards.

The main task of the government (including legislative body and regulatory agencies) is to formulate laws and policies and supervise the implementation of them. Since the government can take coercive measures, its attitude towards ESG largely determines its future trend, and the attitude of enterprises, financial institutions and investors towards ESG also depends on it. From the perspective of ESG's sustainable development goal, its long-term nature is bound to conflict with the enterprise's short-term profit purpose. Therefore, the government needs to formulate a scientific and efficient evaluation system to coordinate its conflict with the financial objectives of enterprises. Large scale deployment in a short time may cause a waste of resources and can not achieve the effect. It can be gradually implemented according to the nature and scale of the enterprise. Enterprises that produce light pollution and green products can be selected to become "leaders", achieve phased objectives in stages and batches, and gradually expand the scope of ESG information disclosure.

References

[1] Han Yu, Xu Haiyan, Chen Lu Conflict analysis of decision maker's combination behavior based on graph model theory [J / OL] Control and decision making, 1-9 [2021-11-25] https://doi.org/10.13195/j.kzyjc.2020.1804.

[2] Meng Hongpeng, Xu Haiyan, Hou Yuhang Research on strength preference ranking based on conflict graph model and strategy priority ranking method [J] China management science, 2016, 24 (9): 7

[3] Zhao Jinshuai, Xu Haiyan Research on conflict inverse problem under ordered preference based on graph model theory [J] Operations research and management, 2018,27 (03): 143-149

[4] Long Yu Research on preference based on decision maker's rationality under conflict analysis graph model [J] Shanxi nongjing, 2020 (02): 13-15 DOI:10.16675/j.cnki. cn14-1065/f.2020.02.007.

[5] Nash J. Non-cooperative Games[J]. Annals of Mathe-matics, 1951, 54(2): 286-295.

[6] Fang L, Hipel K W, Kilgour D M. A Decision Support System for Interactive Decision Making: the Graph Model for Conflict Resolution [M]. New York: Wiley, 1993.

[7] Howard N. Paradoxes of Rationality: Theory of Meta-games and Political Behavior [M]. Cambridge, MA: MIT Press, 1971.