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Climate promotion tournaments and collaborative governance: central-local dynamics in China's carbon neutrality policy implementation

Abstract

The "promotion tournament" constitutes a hierarchical incentive mechanism wherein superior governments incentivize subordinate officials by conditioning career advancement on demonstrably outperforming their peers, thereby securing recognition and upward mobility within the administrative hierarchy. This study introduces the novel theoretical construct of "climate promotion tournaments"—a conceptual innovation examining whether competitive intergovernmental dynamics can be harnessed to foster collaborative governance between central and local governments. Employing a mixed-methods approach that synthesizes empirical extensive field studies with systematic documentary analysis, we formulate an evolutionary game model to rigorously analyze strategic interactions, behavioral dynamics, and equilibrium stability under China's carbon neutrality policy implementation. Results indicate that an ideal equilibrium involves the central government effectively advancing the climate promotion tournaments, while local governments actively engage in these tournaments. Economic capacity and promotion prospects are two key factors in central-local dynamics within climate promotion tournaments. As the economy grows faster and promotion prospects increase, the central and local governments become more active in advancing climate promotion tournaments, which in turn makes it easier to form collaborative governance. The findings validate the efficacy of climate promotion tournaments in fostering central-local collaborative governance, while also extending theoretical frameworks and practical insights to improve carbon neutrality policy implementation.

Keywords

Environmental policy, Climate change, Carbon neutrality, Promotion tournament, Collaborative governance

1 Introduction

Climate change poses one of the most profound challenges to global sustainable development, compelling nations worldwide to announce ambitious carbon neutrality pledges (Stechemesser et al., 2024). The transition from pledge to practice, however, presents a formidable governance challenge (Herman et al., 2025). Effective implementation has emerged as the critical next phase, demanding not just policy design but coordinated execution across all levels of government. The success of this endeavor hinges on the ability to foster genuine collaboration between central and local authorities, ensuring that national decarbonization strategies are effectively translated into local action (Li & Xing, 2024).

To align local implementation with national priorities, governance systems often employ

hierarchical incentive mechanisms (Liu et al., 2025). This is particularly evident in China's governance model, where structured political incentives have profoundly influenced policy outcomes (Bai et al., 2025). Within public bureaucracies where direct financial rewards are limited, career advancement serves as the primary motivator (Dixit, 2002; Fan & Sheng, 2022; Zhang et al., 2025a). Scholars have applied tournament theory to explain China's development through the framework of "political promotion tournaments", where local officials' career progression became directly linked to regional economic performance (Zhou, 2017; 2022; Yan & Yuan, 2020). This institutional arrangement created powerful competitive dynamics that drove exceptional economic growth, with China achieving an average annual GDP growth rate of 8.9% from 1978 to 2023, significantly outpacing the 3.0% global average during this period (Yu & Shen, 2022; Xu, 2024). With the growing scale and complexity of environmental challenges, the administrative incentive structures progressively evolved to systematically integrate ecological and sustainability criteria into their evaluation frameworks (Lo et al., 2020; Zhang et al., 2025a). The emergence of "environmental promotion tournaments" represents a pivotal development where key pollution indicators, including air and water quality standards, were directly tied to local officials' performance evaluations and promotion prospects (Tang et al., 2021; Qi & Liang, 2025). This institutional innovation achieved two significant effects: first, it established a formal institutional channel for integrating environmental objectives into the core assessment system for local officials; second, it created a powerful behavioral incentive mechanism that enhanced governance effectiveness and promoted a more balanced development approach (Wang & Lei, 2021; Zhang et al., 2025a; Qi & Liang, 2025).

Existing research on political and environmental promotion tournaments has effectively traced the evolution of bureaucratic incentives, demonstrating how career motivations have been progressively aligned with economic growth and environmental protection goals (Qi & Liang, 2025; Liu et al., 2025). However, these literature primarily adopts a static, descriptive perspective, treating tournaments as established institutions rather than dynamic systems of strategic interaction. As a result, it provides limited insight into the specific bargaining processes, adaptive behaviors, and evolving games that characterize central-local relations within these frameworks. Most notably, it has not addressed the crucial question of whether these competitive mechanisms can be intentionally designed to foster collaborative governance, wherein different levels of government work in synergy rather than in tension.

This question gains particular urgency in the context of global carbon neutrality, which necessitates a profound systemic transformation (Stechemesser et al., 2024). Achieving carbon neutrality introduces challenges that differ fundamentally from conventional pollution control. These challenges are marked by unprecedented scale, deep technical and economic complexity, and inherent strategic uncertainty (Buffier et al., 2025; Zhou et al., 2025b). Such distinctive features create a novel governance environment for which existing tournament models are increasingly inadequate. These tournament models, having been originally developed to explain growth-oriented or pollution-control dynamics, are ill-suited to address the unprecedented challenges of climate governance.

In response, this study introduces the innovative concept of "climate promotion tournaments" and employs a mixed-methods approach to investigate the complex strategic

dynamics between central and local governments within this novel incentive framework. By integrating extensive qualitative field studies with quantitative evolutionary game modeling, we rigorously identify the conditions under which climate promotion tournaments can foster central-local collaboration and enhance carbon neutrality policy implementation.

Building on this foundation, our study advances the discourse through three key contributions. Theoretically, we advance tournament theory by constructing and validating the novel theoretical concept of climate promotion tournaments, which systematically integrates climate performance into the hierarchical incentive framework. This conceptual innovation not only broadens the theory's explanatory scope beyond economic and environmental domains but also provides a dedicated analytical lens for understanding governance dynamics in the critical era of deep decarbonization. Practically, by identifying adequate economic capacity and credible promotion prospects as pivotal factors enabling stable, collaborative equilibria, the study provides concrete guidance for designing incentive systems. These insights can help policymakers structure promotion tournaments in ways that foster genuine intergovernmental collaboration and enhance the effectiveness of carbon neutrality policy implementation. Methodologically, this study demonstrates the value of a rigorous mixed-methods design. By integrating extensive qualitative field studies with a formal evolutionary game model, we transcend the limitations of purely qualitative or quantitative approaches. This synthesis enables us to both ground our analysis in the nuanced realities of bureaucratic behavior and rigorously model the complex strategic interactions and evolutionary pathways between central and local governments.

2 Literature Review

Tournament theory, developed by Lazear & Rosen (1981), was first applied to the discipline of business management. The tournament model prioritizes motivation through competition, focusing on relative rankings rather than absolute performance criteria (Kale et al., 2009). Participants are evaluated against one another, with higher performers recognized or promoted based on comparative success, not fixed standards (Baker et al., 1988; Connelly et al., 2014).

The application of this theory extends significantly into public administration. Unlike private firms, public organizations often face constraints in offering competitive monetary incentives (Fan & Sheng, 2022). Consequently, non-monetary rewards, particularly career promotion, emerge as a paramount motivational mechanism for public officials (Dixit, 2002; Zhang et al., 2025a). In this context, tournament theory is adapted to hierarchical governance, where superior governments design evaluation metrics to stimulate horizontal competition among subordinates, directly linking tournament outcomes to career progression (Holmstrom & Milgrom, 1991; Liu et al., 2025). This foundational logic has paved the way for more specific conceptual adaptations tailored to distinct policy domains and political contexts, most notably the political promotion tournament, the environmental promotion tournament, and the emerging concept central to this study, the climate promotion tournament (Table 1).

Table 1 A comparative overview of promotion tournament models.

Concept	Core driver and key features	References
Political promotion tournament	Core driver: Economic growth (e.g., GDP). Key features: Economic competition; regional rivalry; promotion incentives; suited for rapid-growth periods.	Zhou, 2017; 2022; Whitford, 2018; Zhang, 2020
Environmental promotion tournament	Core driver: Environmental performance (e.g., pollution control). Key features: Dual tasks; goal trade-offs; strategic compliance; "greening" of evaluation systems.	Wang & Lei, 2021; Tang et al., 2021; Yin & Wu, 2022; Qi & Liang, 2025
Climate promotion tournament	Core driver: Climate performance (e.g., carbon emission, renewable energy share). Key features: Systemic decarbonization; scale and stringency, technical and economic complexity, strategic uncertainty.	/

Its application within hierarchical governance systems shows how competitive incentives can significantly shape bureaucratic behavior and policy outcomes (Whitford, 2018). This is notably illustrated in China's administrative framework through the political promotion tournament, a mechanism in which higher-level governments stimulate competition among local officials by tying career advancement to performance on prioritized targets (Chen et al., 2017). In its classic form, the tournament's core driver has been economic growth, particularly GDP, leading to strong regional rivalry and offering clear promotion incentives, which proved especially effective during periods of rapid economic expansion (Zhou, 2017). By leveraging the country's vertical power structure, this model motivated local officials to prioritize regional economic development, thereby contributing substantially to sustained high GDP growth and shaping China's broader economic governance trajectory (Zhang, 2020; Zhou, 2022).

As environmental degradation intensified, the singular focus on economic growth in promotion tournaments became increasingly untenable (Bai et al., 2025). This led to the conceptual development of the environmental promotion tournament, signifying a critical shift (Tang et al., 2021; Yin & Wu, 2022; Qi & Liang, 2025). Environmental performance indicators, such as those for pollution control (e.g., air and water quality), were incorporated into the evaluation system for local officials (Wang & Lei, 2021; Liu et al., 2025). This transformation created a more complex incentive structure where officials must navigate the "dual tasks" of fostering economic growth while meeting environmental mandates, often leading to strategic tensions and games of interest between central and local governments (Li & Xing, 2024; Bai et al., 2025).

While the evolution from political to environmental promotion tournaments laid important groundwork, the climate governance era necessitates a further conceptual leap. The pursuit of ambitious carbon neutrality, a global imperative exemplified by China's national goal, creates a distinct governance phase that demands deep socio-economic transformation (Stechemesser

et al., 2024). This reality exposes a growing tension with existing tournament frameworks, which were not designed to account for the scale and complexity of such systemic decarbonization. These distinctive features are characterized by three key dimensions that collectively define the governance challenge. First, the scale and stringency of climate targets are fundamentally different; carbon neutrality represents an absolute, long-term commitment, creating far stricter constraints than earlier relative pollution goals (Buffier et al., 2025). Second, achieving these targets entails immense technical and economic complexity, requiring systemic restructuring of energy and industrial systems. This complexity, coupled with high upfront costs and distributional impacts, inevitably intensifies bargaining between central and local governments over resources and responsibilities (Zhang et al., 2024; Herman et al., 2025). Third, the path forward is characterized by significant strategic uncertainty. With less prescriptive regulatory blueprints, local governments must engage in greater policy experimentation, transforming top-down implementation into a more complex, iterative game (Li & Xing, 2024; Zhou et al., 2025a).

The scale, complexity, and uncertainty of climate governance create a distinct strategic environment that existing tournament frameworks are ill-equipped to explain. While effective for analyzing growth-focused or pollution-control tournaments, these frameworks fall short in modeling the intricate strategic bargaining and adaptive interactions that emerge between central and local governments under climate mandates. This theoretical gap leaves a critical question unanswered: how do intergovernmental dynamics evolve when officials must simultaneously pursue economic performance and deep decarbonization? To answer this, a more robust analytical framework is needed—one that can systematically dissect how these competing priorities reshape strategic decisions, recalibrate cost-benefit evaluations, and ultimately, identify the conditions under which genuine collaboration across government levels becomes possible for achieving carbon neutrality.

To address these gaps, this study introduces and rigorously analyzes the climate promotion tournament as a distinct governance mechanism. By developing an evolutionary game model grounded in extensive field studies in China, this research provides a dynamic analytical lens that moves beyond descriptive accounts. It illuminates the strategic interplay between central and local governments, identifies economic capacity and promotion prospects as key determinants of stable governance equilibria, and offers novel insights into fostering collaborative climate governance during global critical carbon neutrality transition.

3 Methods

This study employs a mixed-methods research design to comprehensively and rigorously examine the strategic dynamics between central and local governments within China's carbon neutrality governance framework. By constructing a quantitative evolutionary game model grounded in extensive field studies (Figure 1), it bridges the gap between observed bureaucratic behavior and formal analytical frameworks while strengthening the validity and explanatory power of the findings (Alexander, 2023; Zhou et al., 2025a; Wu et al., 2025).

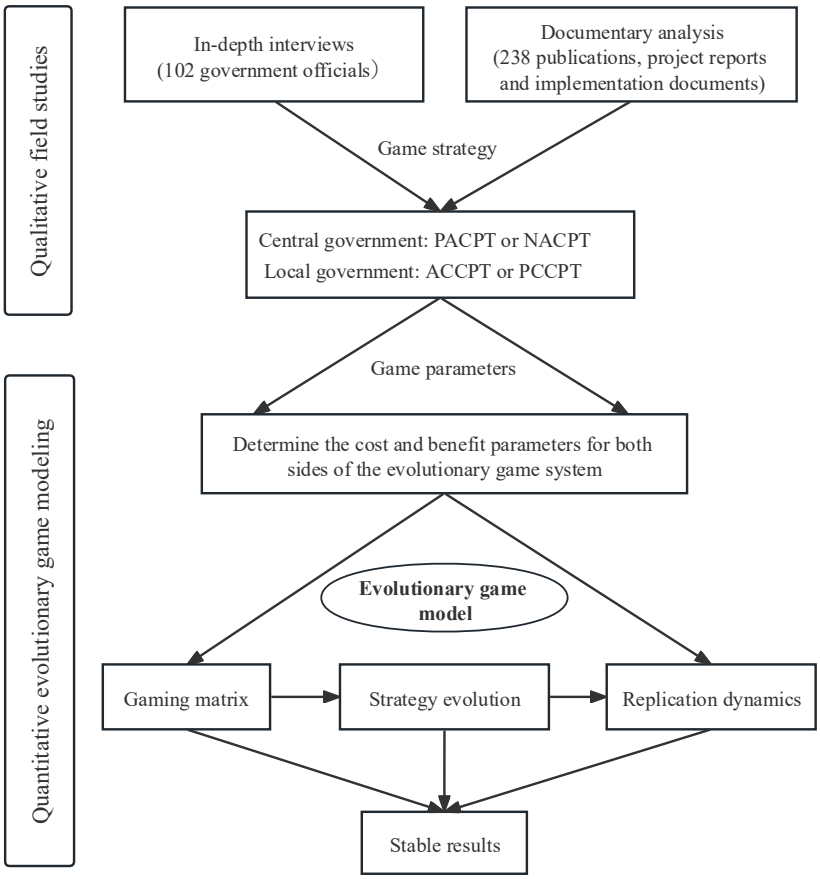

Figure 1 The framework of research methods.

3.1 Qualitative field studies

To capture the nuanced realities of carbon neutrality policy implementation, we conducted extensive qualitative field studies from 2022 to 2025. The field studies consisted of two complementary components: in-depth interviews and systematic documentary analysis.

We conducted 102 in-depth interviews with government officials across multiple administrative tiers, including central ministries and local departments. Participants were selected through purposive and snowball sampling to ensure representation across diverse geographic regions and functional roles related to carbon neutrality policy implementation. The sample spanned 18 provinces, capturing perspectives from officials in key functional departments governing climate and economic affairs, including Development and Reform Commissions, Ecology and Environment Bureaus, and Industry Departments. Each interview, lasting between 60 to 120 minutes, was carefully designed to explore key dimensions of bureaucratic conduct within promotion tournaments. These dimensions included officials' initial perceptions of the climate tournament mechanism, their strategic adaptations in response to evolving policy signals and incentive structures, and the underlying cost-benefit calculations shaping their engagement.

To complement and validate the interview findings, we undertook a systematic documentary analysis of 238 publications, project reports, and implementation documents

related to carbon neutrality and promotion tournaments. These documents were gathered from two main sources: first, published materials on carbon neutrality policy implementation and promotion incentives collected during this research; second, project reports and implementation documents provided by central and local government departments.

The integration of interview and documentary evidence enabled us to construct a detailed and empirically grounded understanding of the strategic environment in which central and local governments interact. Several key insights emerged that directly informed the evolutionary game model, including: the dual pressure on government officials to pursue both economic growth and decarbonization, the factors that shape the strategic motivations and interactive dynamics between central and local governments, the varying cost-benefit structures associated with active versus passive engagement, and the conditional nature of intergovernmental collaboration. These insights were instrumental in defining the strategy sets and cost-benefit parameters of the evolutionary game model, ensuring it remained closely aligned with observable governance realities.

3.2 Quantitative evolutionary game modeling

Building on the empirical foundation established through field studies, we developed an evolutionary game model to formally analyze the dynamic and strategic interplay between central and local governments. Evolutionary game theory is particularly appropriate for this context because it accommodates bounded rationality, adaptive learning, and population-level strategy evolution (Alexander, 2023). These features resonate strongly with the gradual and interactive nature of policy implementation observed in the qualitative study (Sandholm, 2020; Wu et al., 2025).

3.2.1 Evolutionary game strategies

The model conceptualizes the central government and local governments as two distinct populations of players engaged in repeated interactions. Each player can choose from a defined set of strategies based on their perceived incentives and constraints (Alexander, 2023). For the central government, the strategic options are to positively advance the climate promotion tournament (PACPT) or to negatively advance the climate promotion tournament (NACPT). For local governments, the options are to actively contest the tournament (ACCPT) or passively contest the tournament (PCCPT). These strategy sets were derived directly from the behavioral patterns identified in interviews and documents, capturing the essential dichotomy between proactive engagement and reluctant compliance.

As for the strategies of central government: (1) The PACPT strategy indicates that the central government is proactively advancing the climate promotion tournament, which integrates numerous climate indicators into local officials' performance assessment. For instance, in May 2024, China's central government launched the "Action Programme for Energy Conservation and Carbon Reduction". This program mandates all local governments to meet binding carbon reduction targets and allocates substantial resources to conduct thorough monitoring and evaluation of local implementation. (2) Conversely, under the NACPT strategy, the central government refrains from actively promoting the climate promotion tournaments,

primarily prioritizing economic growth.

In terms of the strategies of local government: (1) Adopting the ACCPT strategy indicates that the local government actively engages in the climate promotion tournament, voluntarily investing administrative, financial and personnel resources. The choice to adopt this strategy is often motivated by officials' desires for career promotion and recognition through successful carbon neutrality policy implementation. Additionally, this might often driven by the necessity to respond multidimensional political pressures and the hierarchical, pressure-based system that demands active engagement to avoid criticism or accountability issues. (2) The PCCPT strategy is characterized by local governments' satisfaction with their current administrative positions and a lack of willingness to actively engage in the climate promotion tournament. Such a stance often prioritizes government performance indicators unrelated to climate governance, such as economic growth. Notably, the PCCPT strategy also includes the local governments adopting 'selective compliance', 'symbolic compliance', or other negative governance behaviors.

It is noteworthy that these strategic choices, as observed in extensive field studies, reflect a reality where officials' decisions are shaped not only by promotion incentives but also by factors such as political pressure, public opinion, institutional inertia, and motivation fatigue. For example, even in the absence of strong personal promotion prospects, intense political pressure from central government can compel local officials to adopt the ACCPT strategy. Drawing on existing research, the evolutionary game framework synthesizes the aggregate considerations linked to choosing active or passive engagement in the tournament, thus capturing the net influence of these broader contextual factors (Sandholm, 2020; Wu et al., 2025).

3.2.2 Evolutionary game parameters and matrix

The cost-benefit structure of the evolutionary game model was carefully calibrated to align with the empirical evidence gathered during the qualitative phase of this research (Zhou et al., 2025a). The calibration process involved defining a set of parameters that reflect the real-world costs and benefits associated with climate promotion tournaments, as observed in the interactions between central and local governments. These parameters account for various strategic considerations (Alexander, 2023), such as the financial and administrative costs of advancing or contesting the climate promotion tournaments, as well as the political and career-related benefits derived from successful carbon neutrality policy implementation (Zhang et al., 2024; Li & Xing, 2024).

To ensure that these parameters comprehensively capture the complex interactions and cost-benefit structures between central and local governments in carbon neutrality policy implementation, we conducted a second round of interviews with government officials. This follow-up validation confirmed the parameters' accurate reflection of strategic realities, producing a model with robust stability across the defined ranges. A detailed explanation of each parameter is provided in **Supplementary Material**, which systematically outlines their empirical basis and operational meaning. Based on these calibrated parameters, the corresponding game matrix between central and local governments is presented in Table 1.

Table 1 Game matrix between the central and local governments.

		Game party "b" (Local governments)	
		ACCPT (y)	PCCPT ($1-y$)
Game party "a" (Central government)	PACPT (x)	$E-H+M, F+H+N$	$E-H, F+H$
	NACPT ($1-x$)	$E, F-C$	E, F

4 Results

This study's results systematically reveal three interconnected dimensions of strategic interaction dynamics: (1) the dynamic evolution, (2) evolutionary trends, and (3) the stability of the evolutionary game system.

4.1 Dynamic evolution in the evolutionary game system

Based on the game matrix in Table 1, the evolutionary game framework captures the dynamic interplay between central and local governments, where both engage in continuous strategic adaptation through mutual learning and behavioral adjustment. Taking the local government as an example, this section elucidates its adaptive behavior by detailing how its strategic benefits evolve, as expressed in the following equations.

First, the strategic benefits of "ACCPT" and "PCCPT" are quantified as follows:

$$U_{b_y} = (F+H+N)\,x\, + (F-C)\,(1-x) \quad (1)$$

$$U_{b_{1-y}} = (F+H)\,x\, + F(1-x) \quad (2)$$

Second, the average benefits of the two strategies for local governments are as follows:

$$\overline{U_b} = U_{b_y} \cdot y + U_{b_{1-y}} \cdot (1-y) \;=\; F + Hx + (N+C)xy - Cy \quad (3)$$

When condition $U_{b_x} > \overline{U_b}$ holds, the "ACCPT" strategy generates above-average returns, leading to progressive growth in adoption rate y over time. Conversely, condition $U_{b_y} < \overline{U_b}$ triggers a decline in y. This dynamic is described by the replicator dynamic equation:

$$G(y) = \frac{dy}{dt} = y(U_{b_y} - \overline{U_b}) = y(1-y)[(N+C)x - C] \quad (4)$$

The steady-state value represents the equilibrium proportion of local governments, denoted as y^*. At this point, y^* must satisfy $\frac{dy}{dt} = 0$.

4.2 Evolutionary trends in game strategies

According to dynamic equation (4), let $G(y) = \frac{dy}{dt}$; the first derivative is:

$$G'(y) = (1-2y)[(N+C)x - C] \quad (5)$$

When $x = \frac{C}{N+C}$, there is always $G(y) = 0$; this indicates that all levels of y are stable.

When the central government adopts the "PACPT" strategy proportionate to $\frac{C}{N+C}$, there is no discernable difference in the benefits derived from the local governments' strategies of actively contesting versus passively contesting the climate promotion tournament for the implementation of carbon neutrality policies. Consequently, all y levels are stable within the local governments.

When $x > \frac{C}{N+C}$, $y^* = 0$ and $y^* = 1$ are two possible stability points. Due to $G'(1) < 0$, $y^* = 1$ is the stable evolutionary strategy for local governments. Under these conditions, when the central government chooses the strategy of "PACPT" exceeding a threshold of $\frac{C}{N+C}$, the local governments will gradually shift from "PCCPT" to "ACCPT"; thus, "ACCPT" becomes the stable evolutionary strategy of the local governments. This adjustment signifies that local governments are more inclined to actively contest in the climate promotion tournament during this period. By providing more financial resources, tangible promotion incentives, or a fairer competitive landscape, the central government could motivate local governments to more actively and collaboratively engage in implementing carbon neutrality policies.

When $x < \frac{C}{N+C}$, due to $G'(0) < 0$, $y^* = 0$ becomes the stable evolutionary strategy of the local governments. In this situation, when the central government chooses the strategy of "PACPT" below the threshold $\frac{C}{N+C}$, then local governments will gradually shift from "ACCPT" to "PCCPT". Consequently, "PCCPT" emerges as the stable evolutionary strategy for local governments. Under these circumstances, both parties will increasingly adopt a passive approach towards the climate promotion tournament, making it challenging to achieve collaborative governance in the implementation of carbon neutrality policies.

4.3 Stability of the evolutionary game system

Drawing on established analytical methods in evolutionary dynamics, Jacobian matrix analysis can determine partial equilibrium stability in differential equation-based group dynamic systems (Sandholm, 2020; Alexander, 2023). By applying the empirically-grounded parameters from extensive field studies and documentary analysis (Zhou et al., 2025a; Wu et al., 2025), Jacobian matrix analysis reveals that two equilibrium points exhibit partial stability within the evolutionary game framework, specifically corresponding to stable strategies $O(0,0)$ and $B(1,1)$. Under these conditions, two distinct strategic patterns emerge: either central government chooses "NACPT" while local governments select "PCCPT", or alternatively, the central government engages in "PACPT" coupled with the local governments' "ACCPT" strategy. Beyond these stable configurations, the system contains a pair of unstable equilibrium

points identified as $C(0,1)$ and $A(1,0)$, along with a single saddle equilibrium designated as $Q(\frac{C}{N+C}, \frac{H}{M})$. The replication dynamics and evolutionary trend between two parties, reflecting these findings, is shown in **Figure 2a**.

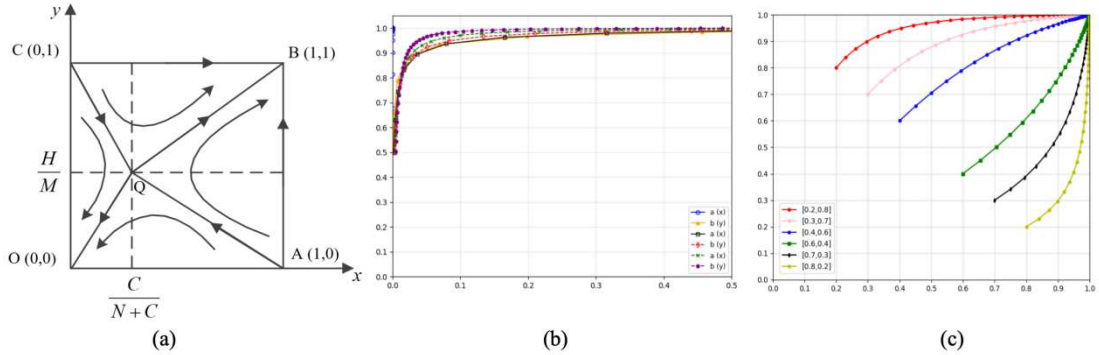

Figure 2 Stability analysis and validation of the evolutionary game system.

Figure 2a demonstrates that the evolutionary game system's convergence trajectory is critically determined by its initial conditions. When the starting position lies within the BCQA quadrilateral, the system stabilizes at equilibrium point $B(1,1)$, reflecting an ideal strategic configuration where the central government implements "PACPT" while local governments adopt "ACCPT". Under this optimal scenario, three synergistic effects emerge: (1) heightened central government emphasis on the climate promotion tournament during carbon neutrality initiatives, (2) proactive local participation in these incentive structures, and (3) consequent amplification of both local policy efficacy and intergovernmental collaboration. This configuration represents the Pareto-efficient result for climate governance, though empirical evidence and theoretical modeling jointly indicate its predominance during the maturation phase of carbon neutrality policy cycles. Conversely, initial states positioned in the OCQA quadrilateral drive convergence toward evolutionary stable strategy (ESS) equilibrium $O(0,0)$, characterized by central "NACPT" and local "PCCPT" strategies. This path generates systemic inertia, manifesting as minimal engagement in the climate promotion tournament by both administrative tiers.

To rigorously validate these results, we conducted sensitivity tests to examine the evolutionary dynamics between central and local governments under diverse parametric conditions. The simulations employed extended time horizons with carefully calibrated iterations to ensure computational stability and asymptotic convergence (Sandholm, 2020; Zhang et al., 2025b). Initial strategy distributions were symmetrically set at (x=0.5, y=0.5), representing an unbiased baseline where half of agents in each group adopted "PACPT" or "ACCPT" strategies respectively. As shown in Figure 2b, all evolutionary trajectories consistently converged to the desired equilibrium of full collaboration, characterized by universal "PACPT" adoption centrally and complete "ACCPT" implementation locally. Sensitivity analyses across the entire parameter space ($x,y \in [0,1]$) with incremental 0.2-0.8 variations confirmed the system's robust convergence to this equilibrium under all tested initial conditions (Figure 2c). These results provide strong empirical validation for our evolutionary

game model, demonstrating reliable ESS convergence that aligns with optimal governance results. The findings not only reinforce the model's theoretical validity but also offer practical insights: properly structured incentive mechanisms can effectively promote stable, collaborative equilibria in the climate promotion tournament.

5 Discussions and implications

Building on the results, this section offers an integrated interpretation of the central-local dynamics, elucidating the evolutionary mechanisms and key conditional factors that shape collaborative climate governance.

5.1 Evolutionary mechanisms and implications in climate promotion tournaments

The evolutionary game analysis reveals that the strategic interaction converges toward two stable equilibria: $O(0,0)$ and $B(1,1)$, along with one saddle point Q. These equilibria carry distinct underlying evolutionary mechanisms and policy implications for understanding the dynamics of hierarchical governance in intergovernmental relations (Alexander, 2023; Zhang et al., 2024).

Equilibrium $O(0,0)$ corresponds to a scenario in which the central government adopts a negative advancement strategy (NACPT) and local governments choose passive contestation (PCCPT). This reflects a governance state in which the climate promotion tournament remains inactive. Our field studies indicate that such a situation tends to emerge during periods of acute socioeconomic disruption, such as the pandemic response phase from 2020 to 2021, when both administrative levels prioritized public health management and emergency stabilization over long-term decarbonization efforts. Similarly, during periods of economic slowdown or fiscal strain, such as the post-COVID recovery phase from 2022 to 2024, short-term economic stabilization has also taken precedence over decarbonization initiatives in intergovernmental priority-setting. In policy terms, this equilibrium represents a state of governance inertia. Without active incentives from the central government and genuine engagement from local actors, progress toward carbon neutrality is likely to stagnate. This highlights a key concern: in the absence of aligned incentives and clear top-down support, climate targets can be easily deprioritized.

By contrast, equilibrium $B(1,1)$ embodies the optimal collaborative result, where the central government actively advances the tournament (PACPT) and local governments actively contest it (ACCPT). This reflects a high collaborative governance pattern, typically observable during periods of sustained economic growth and strong institutional encouragement. The policy implication is that a well-structured tournament can align central and local interests, transforming competitive dynamics into collaborative governance. When both sides commit resources and political capital, the tournament does not merely accelerate policy implementation; it also builds mutual trust and facilitates resource sharing. These elements are essential for achieving the systemic decarbonization required by carbon neutrality goals.

The saddle point Q marks a critical threshold in the strategic landscape. Its position determines whether the system evolves toward collaborative or inactive results. In policy terms, Q acts as a tipping point in central-local dynamics. When central government increase its cost

investments in the climate promotion tournament, the saddle point Q shifts southwestward. This expands the region within which the system converges toward the optimal collaborative equilibrium $B(1,1)$. This means that well-calibrated incentives, such as targeted fiscal transfers, clearer promotion pathways, or enhanced institutional support, can motivate local governments to shift from passive to active engagement. In practice, this suggests that tournament design must be not only competitive but also supportive, reducing the perceived risks and implementation costs for local actors (Li & Xing, 2024).

Our field studies corroborate these interpretations. Officials consistently noted that collaboration is strongest when the central government provides not only mandates but also adequate resources and meaningful recognition. For instance, during high-growth periods such as 2012 to 2019, both central and local governments increased their investments in environmental and climate tournaments, which led to measurable policy gains. Conversely, during economic downturns, engagement weakened, revealing the dual nature of tournaments: they can drive climate performance, yet they may also be viewed as a potential constraint on economic growth (Zhou et al., 2025b). This tension underscores the importance of the economic context in shaping the effectiveness of the climate promotion tournament, a theme we further examine in the following section.

Moreover, the shift from passive to active strategies is not determined solely by economic conditions. As local officials emphasized in interviews, the perception of promotion prospects critically influences their willingness to engage. Even in economically vibrant regions, if officials perceive limited promotion prospects, their motivation to actively participate in climate tournaments diminishes. Our model further clarifies this mechanism: when the central government provides credible promotion prospects, it raises the parameter H (the cost of advancing the tournament). This shifts the system dynamics toward the collaborative equilibrium $B(1,1)$, where both central and local governments actively engage in climate governance. These credible promotion prospects act as a key catalyst, helping sustain collaborative momentum and reduce the likelihood of reverting to passive strategies, especially during periods of policy uncertainty or implementation fatigue (Zhou, 2022).

5.2 Economic considerations in central and local government dynamics

The results from the evolutionary game system demonstrate that both central and local governments tend to advance climate promotion tournaments negatively when economic capacity is limited, as observed during the post-COVID-19 economic recovery period from 2022 to 2024. Extensive field studies indicate that insufficient investment (e.g., low levels in cost parameters H and C) by central and local governments in climate promotion tournaments typically occurs during periods of constrained economic capacity. In interviews, officials directly linked fiscal constraints to strategic priorities, noting that lower revenues strongly incline governments to favor economic performance over environmental and climate goals. This tendency is especially pronounced in regions dependent on high-energy or high-carbon industries, given their critical role in local economic growth (Zhou et al., 2025b). This prioritization is often reinforced by entrenched institutional inertia favoring short-term economic gains, as well as motivational fatigue among officials navigating complex and long-

term decarbonization mandates amidst competing policy pressures.

Conversely, during periods of rapid economic growth, such as from 2012 to 2019 before COVID-19, local governments were more proactive in engaging in climate promotion tournaments (China Newsweek, 2020). Similarly, the central government, buoyed by substantial financial revenues, invests more resources into these tournaments. It not only established a differentiated climate performance assessment mechanism to accommodate the diverse economic statuses and resource endowments of various regions but also enhanced systems for collecting, processing, and publicizing information related to climate tournaments. Furthermore, benchmarks were set for top-performing local governments to foster a competitive yet collaborative environment for improving climate performance (Yin & Wu, 2022; Qi & Liang, 2025). Additionally, given the limited number of promotion positions available, local government officials who have not been promoted but have shown progress are also awarded alternative rewards—both material and spiritual, such as bonuses, recognition, and commendations. Such reward diversification helps sustain motivation when promotion prospects are limited, addresses potential motivational fatigue, and aligns governance actions with growing public sentiment for environmental stewardship (Fan & Sheng, 2022).

Local governments, particularly in regions experiencing rapid economic growth or those that have nearly completed their industrial restructuring, often prioritize climate performance to secure promotions for local officials (Meng et al., 2019). In these areas, the importance of economic growth for career advancement has diminished, making climate performance a more significant factor (Yuan & Jiang, 2020). Moreover, field studies have also highlighted a notable trend in regions with consistently low economic rankings. These areas, lacking competitive edges in economic performance for career development, proactively engage in climate promotion tournaments. For instance, Huangshan city in Anhui Province, which has historically lagged in economic growth, has chosen to prioritize environmental and climate governance. This strategic focus has enabled it to improve its standing in environmental and climate performance rankings, thereby enhancing the promotion advantage of its local officials (Yuan & Jiang, 2020).

These observations suggest that the pursuit of climate performance can serve as a strategic avenue for local officials seeking promotions, especially when traditional paths via economic achievements are less viable. These findings advance our understanding of tournament-driven local mobilization, with direct implications for institutionalizing vertical compliance mechanisms during carbon neutrality policy implementation.

5.3 Promotion prospects of local officials in climate promotion tournaments

It is worth noting that some local governments may be less inclined to invest in climate promotion tournaments even in times of high economic growth. One common feature that emerged during interviews was that officials perceived themselves as lacking credible promotion prospects. In the view of theories such as prospect theory, expectancy theory and incentive theory, promotion prospects are an important factor influencing individual behavioural choices and cost inputs (Bai et al., 2025; Belle et al., 2025). Existing scholars have also suggested that promotion prospects are the perceived opportunities for advancement

among local government officials, serving as the logical foundation for both the initiation of Chinese promotion tournaments and the fundamental motivation of officials (Meng et al., 2019; Xie & Yang, 2021; Zhou, 2022).

According to the field studies and the results from the evolutionary game model, the credible promotion prospects would lead the local governments to readily choose the strategy of "PACPT", committing to continuous investments (the cost parameter *C*) in contesting the climate promotion tournaments. In other words, when local officials believe that excelling or meeting carbon neutrality policy targets boost their chances of future promotion, they are more likely to invest more thoroughly in contesting the climate promotion tournament.

Moreover, considering many local officials are facing the dilemma of motivation fatigue, and the phenomena of "career barriers", this leaves room for further stimulating the motivational effects of promotion prospects (Zhou, 2022). Effectively countering motivational fatigue requires not only clear promotion signals but also supportive measures that sustain long-term engagement and reduce the perceived burden of policy implementation. As many local officials said in the interviews "*We anticipate that the central government will actively promote the climate promotion tournaments if they are coupled with genuine promotional opportunities.*" "*Beginning in 2025, as our local economies start growing rapidly again, the prospects for promotion are expected to become a major incentive for engagement*". Building on these insights, explicitly linking credible promotion prospects to climate performance can more effectively channel local governments' efforts toward implementing carbon neutrality policies and fostering collaborative climate governance (Li & Xing, 2024).

5.4 Theoretical contributions and practical implications

This study advances the integration and innovation of promotion tournament theory and collaborative governance theory. Theoretically, it extends tournament theory from the traditional domains of economic growth and pollution control to the more systemic, complex, and long-term arena of climate governance, proposing the novel conceptual construct of climate promotion tournaments. This enriches the theoretical spectrum on the relationship between incentive structures and governmental behavioral dynamics. Furthermore, the research reveals that, under specific conditions such as adequate economic capacity and credible promotion prospects, competitive incentive mechanisms can be transformed into drivers of collaborative governance. This provides new evidence from the bureaucratic context for understanding the classic governance puzzle of "how competition fosters collaboration", thereby enhancing the dynamism and conditionality of collaborative governance theory in explaining multi-level government interactions.

While grounded in China's hierarchical governance context, the core logic of the climate promotion tournament holds significant potential to inform climate governance in other political and administrative systems. The two key enabling conditions identified—adequate economic capacity and credible promotion (or reputational) incentives—are not unique to China. Therefore, the framework and findings of this study offer broadly applicable policy insights for global climate governance systems.

First, when formulating Nationally Determined Contributions (NDCs) and long-term

strategies, countries could explore systematically integrating carbon neutrality targets into the performance evaluations and promotion systems for local officials, constructing “green promotion pathways” centered on climate performance. This would translate macro-level commitments into sustained incentives for local action.

Second, central or federal governments should emphasize designing supportive tournament mechanisms for carbon neutrality policy implementation. Beyond rankings and accountability, these must be coupled with matching fiscal resources, technical assistance, and capacity building, particularly to help less-developed regions manage transition costs. This addresses participation fatigue and resistance stemming from resource disparities, enhancing the fairness and effectiveness of the tournament system.

Third, policy design must remain responsive to economic cycles. During periods of slower growth, climate goals risk being deprioritized under fiscal and developmental pressure. To sustain local engagement, policymakers can introduce more flexible policy instruments. These may include phased carbon neutrality targets that adapt to economic conditions, alongside non-material incentives such as public recognition and reputational awards. Targeted funding for transitional measures can further help align short-term economic stability with long-term decarbonization, ensuring climate objectives are not systematically marginalized.

Fourth, in line with the need for a more granular understanding of local behaviour, policymakers should move beyond a binary view of local compliance. Central governments can design differentiated incentive packages by first identifying distinct local response types. For example, front-runner localities may benefit from enhanced autonomy, while resource-constrained actors might require combined technical and financial assistance. Similarly, symbolic compliers could be guided through stronger oversight and clear performance feedback. This typology-based approach ensures that incentives and support are better matched to local realities, fostering more genuine and widespread engagement in the climate governance tournament.

These policy implications, while potentially relevant to other nations, should be thoughtfully adapted to distinct political and administrative contexts. Such adaptation would require operationalizing the core logic of climate promotion tournaments through context-specific instruments, such as inter-jurisdictional performance benchmarks, conditional fiscal transfers, or public recognition schemes, particularly in systems where subnational authorities hold significant implementation discretion. This potential for adaptation underscores the broader relevance of our findings and invites future comparative research to test how specific administrative cultures, fiscal structures, and political accountability models shape the efficacy of such incentive-based governance.

5.5 Limitations and future research

While this study offers a valuable framework for analyzing collaborative climate governance, certain aspects merit further development to broaden its scope and application.

First, the evolutionary game model adopted in this study utilizes a simplified binary strategy framework to capture core strategic interactions. This theoretical simplification prioritizes analytical clarity, but may not fully represent the continuous and nuanced spectrum

of policy implementation behaviors. To address this, a fruitful future direction is to develop a more granular, empirically grounded typology of local government responses. Survey data or comparative case studies could identify distinct behavioral archetypes. These refined categories could then inform the construction of richer agent-based or evolutionary models with multiple strategy sets, moving beyond the binary framework to better simulate real-world complexity.

Second, the model is empirically grounded and validated within China's specific governance context. This provides valuable analytical depth, but it also means that applying the framework directly to other political systems would need to account for their distinct institutional arrangements. The particular conditions that make promotion tournaments particularly effective in China, such as a centralized personnel management system, are not universally present. To enhance generalizability, future research should examine how climate promotion tournaments function in varied political systems, including federal structures, through comparative analysis essential for refining the framework within broader global governance debates.

6 Conclusions

The climate promotion tournament constitutes an effective institutional mechanism through which the central government incentivizes local governments to enhance climate policy implementation and collaborative governance. However, the inherent divergence of interests between these two administrative tiers inevitably generates strategic gaming behavior within the climate governance system. Grounded in extensive qualitative field studies, this study develops an evolutionary game framework to rigorously analyze the strategic interactions between central and local governments, quantitatively modeling the dynamic interplay in their carbon neutrality policy implementation. The results demonstrate that central and local governments can reach an optimal equilibrium point where both parties maximize benefits from the climate promotion tournaments and establish collaborative governance in implementing carbon neutrality policies. Two key conditions for reaching these optimal results include adequate economic capacity and the provision of credible promotion prospects for local officials. The study extends tournament theory to systemic decarbonization, advances collaborative governance theory by revealing how competitive incentives foster collaboration, and provides policymakers with actionable insights for enhancing central-local climate governance.

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