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Study on the Parallel Competition Governance Model of Multiple Subjects in the "Unveiling of the List of Commanders"

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ABSTRACT

Improving the " The open competition mechanism to select the best candidates " system to fully stimulate innovation vitality is the key to Improving the " The open competition mechanism to select the best candidates " system to fully stimulate innovation vitality is the key to implementing key core technology breakthroughs and accelerating the resolution of the " bottleneck " problem. This article investigates the practice of " The open competition mechanism to select the best candidates " in Sichuan Chongqing's scientific and technological research, and summarizes the policy texts of " The open competition mechanism " in Sichuan Chongqing. This article investigates the practice of " The open competition mechanism to select the best candidates " in Sichuan Chongqing's scientific and technological research, and summarizes the policy texts of " The open competition mechanism to select the best candidates " in various provinces and cities. amounts in the early stage of "The open competition mechanism to select the best candidates" and the selection of incentive models in the later stage of project supervision are the focus of attention for Sichuan's scientific and technological research. project supervision are the focus of attention for the "issuing party" and the government. Therefore, it is an important and urgent issue to explore the early stage list amount setting and post project supervision. early stage list amount setting and post project supervision of "The open competition mechanism to select the best candidates", especially to effectively incentivize multiple "unveiling parties" to increase efforts and accelerate research, and to improve the "The open competition mechanism to select the best candidates" system design The open competition mechanism to select the best candidates" system design to continuously promote cutting-edge technology research and development, and help achievetechnological self-reliance and self-improvement.In order to solve the problem of effectively encouraging the "unveiling party" to increase its efforts to accelerate the breakthrough of key core technologies under the fixed amount of the list, and effectively setting the amount of the list under the unfixed amount of the list to achieve the unity and unity of purpose. technologies under the fixed amount of the list, and effectively setting the amount of the list under the unfixed amount of the list to achieve the unity and self consistency of encouraging the "unveiling party" to make efforts to invest and avoid the need for the "unveiled party" to invest in the technologies. self consistency of encouraging the "unveiling party" to make efforts to invest and avoid its opportunism, this paper summarizes the "unveiling party" This paper summarizes the "unveiling party" parallel competition governance model as: static championship governance model Dynamic "milestone" governance model and post bidding governance model, and modeling and numerical control of the "unveiling party". model, and modeling and numerical simulation of the interactive behavior of the "publishing party" and "publishing party" during the operation of "The open competition mechanism to select the best candidates". open competition mechanism to select the best candidates" under the three governance models, respectively Research has found that the three types of governance models have their own applicable scenarios, influenced by factors such as pay gap, marginal R&D costs, volatility of scientific research output, and observability. For example, the static championship governance model is suitable for ranking projects with shorter cycles and higher observability of results; the dynamic "milestone" governance model adopts adopts a more flexible approach. For example, the static championship governance model is suitable for ranking projects with shorter cycles and higher observability of results; The dynamic "milestone" governance model adopts node assessment and survival of the fittest, which is

suitable for ranking projects with shorter cycles and higher observability of results. For example, the static championship governance model is suitable for ranking projects with shorter cycles and higher observability of results; The dynamic "milestone" governance model adopts node assessment and survival of the fittest, which is suitable for ranking projects with high difficulty, long cycles, and can be divided into typical stages; The post auction governance The post auction governance model helps to reasonably determine the amount of the list and avoid opportunism behavior, and is applicable to projects where the government or the " issuer" cannot accurately estimate the amount of the list and avoid opportunism behavior. issuer" cannot accurately estimate the R&D cost due to difficulties in technical prediction. Based on this, this article proposes suggestions for optimizing and improving the governance mechanism of R&D cost. optimizing and improving the governance mechanism of key core technology breakthroughs in terms of improving the "The open competition mechanism to select the best candidates" listing mechanism, improving the "The open competition mechanism to select the best candidates" organizational management, and optimizing the "The open competition mechanism to select the best candidates" organizational management. management, and optimizing the "The open competition mechanism to select the best candidates" incentive mechanism.

KEYWORDS

" The Open Competition Mechanism to Select the Best Candidates "; Static Championship; Dynamic 'Milestones'; Post Auction.

1. INTRODUCTION

High-level scientific and technological self-reliance and self-improvement is a new journey to comprehensively build a modern socialist country and comprehensively promote the great rejuvenation of the Chinese nation in the history of the road, key core technology independent and controllable is an important cornerstone of scientific and technological self-reliance and self-improvement . The Outline of the Fourteenth Five-Year Plan for the National Economic and Social Development of the People's Republic of China and the Vision 2035 proposes to reform the way of establishing and organizing the management of major scientific and technological projects, and to implement the system of "revealing the list of commanders" and "horse racing", so as to provide a platform for the development of key core technologies, and for the long-term development of the Chinese nation. This has provided guidelines for short-term emergency research and long-term strengthening of the foundation. According to statistics, governments or departments at all levels across the country have successively issued more than 200 regulations and documents related to the key core technology research and development, and have cumulatively issued more than 1,200 lists of projects with more than 250 units. Attack0 The "List and Commander-in-Chief" has become an important way and policy practice to strengthen the precise allocation of scientific and technological resources and accelerate the cracking of "neck-breaking" technological problems, and has received wide attention from all walks of life.

Around the key core technology research and development, "the list of commanders" to carry out in-depth research is also the current academic hotspot. The origin of the "List of Commanders" is the "Science and Technology Bounty", which is a non-periodic reward system deployed to solve problems in specific fields.[2] It is a non-periodic reward system deployed to solve problems in specific fields.[3] The operation process mainly consists of three phases: collection of demands for scientific and technological projects and issuance of the list, application and validation of the list, and supervision and acceptance of the project.[4] Existing research centers on the overall operation mode of "unveiling the list of marshals", the strategy of setting the list in the early stage, the mechanism of "selecting marshals-determining marshals-hanging marshals" in the middle stage, as well as the mechanism of "list" and "marshal". The characteristics of matching between the "list" and the "marshals" have been carefully analyzed.[3]0 In addition, it has enriched the theoretical

understanding of the system of "revealing the list of marshals", but it still needs further in-depth research on the supervision of the projects in the later stage of "revealing the list of marshals", especially the effective incentive for multiple "revealing parties" to increase the input and accelerate the research and study. However, further in-depth research is still needed to provide theoretical reference for the scientific selection of the governance mode in the parallel competition of multiple subjects in the system of "disclosure of the list of commanders".

At the same time, the research group in the Sichuan and Chongqing science and technology authorities to carry out key core technology research "list of commanders" practice research found that the "list of commanders" pre-listing of the project amount set and the later project supervision in the incentive model selection is the "issuer" and "revealer" particularly concerned about the focus. The focus of attention of the "list issuer" and "list revealer" is particularly important. On the one hand, the size of the project list is directly related to the success of the list. If the amount of the list is too low, the attraction will be limited, and it will be difficult to mobilize the potential publishers to participate in the list, so that the precise matching of research resources cannot be achieved. However, too high an amount will lead to a waste of financial resources and even induce collusion and corruption, so the scientific and reasonable setting of the list amount is a difficult problem in the actual implementation of "list of commanders". On the other hand, scientific research activities are unobservable and highly uncertain.[6]-[8] For the relative lack of technical information and professional advantages of the government, it is difficult to effectively supervise and manage the R & D personnel or the R & D process of the "listed party" as in the case of material production activities, which leads to an easy to fall into the misunderstanding of the project progress on the merits.[9] In addition, it is difficult to effectively supervise and manage the R&D personnel or the R&D process like material production activities, which makes it easy to fall into the misconception that the progress of a project is the best or the worst, i.e., to require the "list holder" to fill in a lot of materials and report the progress, which is contrary to the result-oriented "list holder" and the reform-oriented "unbundling" of scientific research. Therefore, how to choose an effective incentive model to reconcile the above contradictions is another difficult problem in the actual implementation of the "List and Commander-in-Chief".

Based on this, this paper, on the basis of systematically sorting out the documents issued by governments at all levels and the relevant project lists, analyzes the interactive behaviors of "list issuer" and "list issuer" in the operation of "list issuer", focusing on the following two issues: First, under the condition of fixed project list amount, how to effectively motivate "list issuer" to increase efforts to accelerate the realization of the project list? On the basis of modeling and analyzing the interactive behaviors of the "list-revealing party" and the "list-revealing party" in the operation of the "list-revealing and marshaling", we focus on solving the following two problems: first, under the condition of fixed amount of the project list, how to effectively motivate the "list-revealing party" to increase the efforts to accelerate the realization of the breakthroughs of the key core technology; second, under the condition of unfixed amount of the project Under the condition of fixed list amount, how to effectively set the list amount to realize the unification and self-consistency of incentivizing the "list-revealer" to put in high efforts and avoiding its opportunism. The conclusions of the study can help improve the incentive mode and scientific setting of the amount of the list, and then provide a decision-making reference basis for the sound governance mechanism of key core technology research and development, which has strong theoretical value and practical significance.

2. PRACTICAL RESEARCH ON THE SETTING AND INCENTIVE MODEL OF "UNVEILING THE LIST OF COMMANDERS".

Science and technology bounties have been an important means of government funding for innovation for more than 300 years, and have greatly contributed to the efficiency of basic research and innovation in Western developed countries such as the United Kingdom, the United States, France

and Germany.[10][11] The essence of the "list of commanders" is similar to that of the S&T bounty. The essence of the "list of commanders" is similar to the science and technology bounty, which is a new system, mechanism and mode oriented by the major science and technology innovation needs, through resource integration and selection of talents, innovative science and technology funding management, and promotion of open innovation and synergistic development, with the characteristics of subject guidance, problem orientation, low threshold, and ex post facto reward.[12] It is a new system, new mechanism and new mode, which is characterized by subject guidance, problem orientation, low threshold and ex post facto rewards, and meets the demand for improving the accuracy of innovation funding in key core technology research.[13][14] It is a feasible direction to improve the accuracy of innovation funding to break the dilemma of innovation funding incentives.[15] It is a feasible direction to improve the accuracy of innovation funding to solve the dilemma of innovation funding incentives.

Since General Secretary Xi Jinping proposed in 2016 at the symposium on network security and informatization that "you can explore to engage in the unveiling of the list of commanders, the need for the key core technology projects out of the list, the hero regardless of provenance, who has the ability to unveil the list" since the key core technology research "unveiling of the list of commanders "Gradually rise as a national strategy, and comprehensively pushed forward throughout the country.[4] The key core technology research and development has been gradually upgraded to a national strategy and comprehensively pushed out nationwide. Practice level, the group of Sichuan Province and Chongqing Municipal science and technology authorities to explore the implementation of scientific and technological research "to reveal the list of commanders" research, the two places in the "to reveal the list of commanders" pre-project amount of money to set up and later incentive model choice has both commonalities and differences, quite Representative. Firstly, in terms of the amount set for the list of "unveiling the list of marshals", the Department of Science and Technology of Sichuan Province adopts a fixed amount, for example, the financial funding for the seven projects in the "2022 Sichuan Major Science and Technology Special Project "Unveiling the list of marshals" list" adopts a fixed amount, ranging from 4 million yuan to 11 million yuan. The financial funding for the seven projects in the "2022 Sichuan Province Major Science and Technology Special Projects" List are all in fixed amounts, ranging from 400 million to 11 million yuan. Chongqing Municipal Bureau of Science and Technology is the amount of money capped but not fixed, the financial funding to give the upper limit but not determine the specific amount, such as 2021 has released two batches of "reveal the list of marshal" project list 7, and ultimately determine the 6 reveal the list of units, involving the list of 58 million yuan, the arrangements for the financial funding of 23.9 million yuan. Secondly, the "reveal the list of commanding" late incentive model, the Sichuan Provincial Science and Technology Department clearly set 7 project R & D time frame, and clear R & D time frame of 3 years or 4 years, respectively, 18 months after the project and 2 years to carry out the "milestone" assessment. Chongqing Municipal Bureau of Science and Technology also implements "milestone" management for project R&D, and implements parallel funding and "horse-racing" management for R&D tasks with higher risks. Such as for Xiushan County electrolytic manganese slag heavy metal content is high and difficult to deal with the problem, choose two different technical routes of the list of parallel funding units, funding allocation mode funding to take "prior funding + node assessment + acceptance of the subsidy" in three stages to the "list of party "Funding allocation method.

Comprehensive Sichuan and Chongqing scientific and technological authorities to explore the actual investigation of the "list of commanders", in order to effectively increase the feasibility of the implementation of the "list of commanders" and to achieve practical results of scientific and technological research, "list of commanders "In order to increase the feasibility of the implementation of the "List and Commander-in-Chief" and to achieve practical results in scientific and technological research, the focus of the "List and Commander-in-Chief" is the setting of the project amount in the early stage of issuing the list and the selection of the incentive mode in the later stage of project supervision.

3. THE "REVEAL AND COMMAND" MULTI-ACTOR PARALLEL COMPETITION GOVERNANCE MODEL

On the basis of the above research on the practice of "unveiling the list of marshals" of Sichuan and Chongqing science and technology authorities, this paper further searches and sorts out the policy texts of "unveiling the list of marshals" of provinces and cities through government portal and Beida Fabulous, and combines the amount of list setting and incentive mode to summarize the following three types of "unveiling the list of marshals" multi-body parallel competition governance modes: 1) Static Tournament Mode. Combined with the amount of the list and the choice of incentive mode, the governance modes of the parallel competition of multiple subjects in the "List Revealing and Commanding" are summarized into the following three categories: (1) Static Tournament Mode. The project will be carried out by multiple "list-unveiling parties" at the same time to conduct competitive research and development, and no stage assessment will be carried out. When the project expires, the "list-unveiling party" will determine the winner by joint assessment with the actual demand unit of the project, and will pay a fixed amount of project funds. (2) Dynamic "milestone" mode. In the course of the project, the "list issuer" implements "milestone" management for key nodes and adopts stage-by-stage appraisal; if the appraisal is passed, a fixed amount of project funds will be disbursed for subsequent projects; otherwise, the project will be suspended and eliminated. (3) Ex post facto bidding model. The "issuing party" does not fix the amount of the list or limit the upper limit of funds, and after the expiration of the project, the "issuing party" determines the winner based on the results of the "unveiling party" and the project offer, and pays the funds of the project offer. The winner will be determined based on the results of the project and the project offer, and will be paid the amount of the project offer.

3.1. Static Tournament Model Analysis

"Under the static tournament governance model, the "list issuer" publicly releases the project's research content, R&D deadlines, and competition rules, etc., and several "list issuers" simultaneously and independently Multiple "listers" simultaneously and independently carry out competitive research and choose their own optimal effort inputs, no stage assessment is carried out during the project period, and after the project expires, the "list issuer" evaluates the winner according to the R&D results submitted by the "listers" and pays a fixed amount of project funds. In this paper, it is assumed that the n "revealers" participating in the parallel competition are homogeneous and risk-neutral, and the winner of the competition receives a fixed amount of project funding M, while the loser only receives a small amount of initial funding m. Due to the unobservable characteristics of scientific research activities, the "revealer" or the evaluation unit cannot fully observe the "revealer" or the "revealer"'s results. Due to the unobservable nature of scientific research activities, the "list issuer" or the evaluation unit cannot fully observe the efforts of the "list issuer", but can only judge the "list issuer" on the basis of the results that it eventually reveals, such as policy recommendations, national standards, patents, and other quantifiable results outputs. Assuming that$y_i = \theta a_i + \varepsilon_i$ The following is a hypothesisy_i is the outcome output, and$0 < \theta < 1$ denotes the level of effort of the "list-revealing side a_i is the observable degree of the "list-maker's" effort, and ε_i are random disturbances and$\varepsilon_i \in U[-q, q]$ and are independent of each other[16] The cost of scientific and technological research of the "revealer" is a convex function of its own effort, i.e. C = and c>0.i$\frac{1}{2} c a_i^2$ and c>0. Let pi be the probability of winning for "debunker" i, then the expected utility of "debunker" i is$EU_i = EI_i - C_i$ =, where$p_t M + (1 - p_i)\mathrm{m} - \frac{1}{2} c a_i^2$ whereEI_t is the expected return of the "revealer".

Since each "revealer" makes decisions independently during the project period, its individual optimal strategy constitutes a pure strategic Nash equilibrium in the static tournament model, such that$\frac{\partial EU_i}{\partial a_t} =$

0 The optimal level of effort of the "list-revealer" is the purely strategic Nash equilibrium level of effort:

$$a_i = \frac{M-m}{c} * \frac{\partial p_i}{\partial a_i} \tag{1}$$

Because the "revealers" are homogeneous, there is no probability space in which one "revealer" deterministically outperforms the other. If the "revealer"i outperforms the "revealer"j and is ranked higher, then there is$\theta a_i + \varepsilon_i > \theta a_j + \varepsilon_j$ that is$\varepsilon_j < \theta a_i + \varepsilon_i - \theta a_j$, so p(i before j||) = p(i before j||) = p(i before j||) = p(i before j||) ε_i) = $\int_{-q}^{\theta a_i+\varepsilon_i-\theta a_j} \frac{1}{2q} d\varepsilon_j = \frac{1}{2q}(\theta a_i + \varepsilon_i - \theta a_j + \mathrm{q})$, then we have$\frac{\partial p_i}{\partial a_i} = \frac{1}{2q}\theta$, which is brought into equation (1) to obtain the equilibrium effort input level:

$$a^* = \frac{M-m}{c} * \frac{\partial p_i}{\partial a_i} = \frac{(M-m)\ \theta}{2qc} \tag{2}$$

"In the static tournament governance model, the difference between the level of effort inputs and payoffs (M-m), the degree of observability of effort inputs, the cost coefficient c, and the volatility of outcome outputs of the "list-maker" side are the same as in the static tournament governance model.θ The level of effort inputs of the "list leader" in the static tournament governance model is related to the remuneration payment differential (M-m), the degree of observability of effort inputs, the cost coefficient (c), and the volatility of outputs$q$ and the volatility of outputs. The government or the "list issuer" can incentivize the "revealer" to invest a high level of effort by increasing the prize payout to the winner. Given that the Static Tournament Governance Model is characterized by one-time payment of funds and no stage assessment, the model is suitable for list projects with low project difficulty, short project cycle (less than one year), and high degree of observability of R&D results. For example, the "Anhui Provincial Science and Technology Department on the release of Anhui Province, the first batch (2021) "to reveal the list of commanding" list of tasks in the announcement of the "semiconductor wafer defect detection equipment" project, they set a detailed demand for the target and the size of the wafer (12-inch), defect detection sensitivity (better than 12-inch), the size of the wafer (12-inch), the size of the wafer, the defect detection sensitivity (good). The project has set detailed demand targets and wafer size (12 inches), defect detection sensitivity (better than 26nm), laser light source (266nm) and other technical specifications and project cycle less than 6 months. For the project of multiple parallel competition situation, the government adopted a static championship governance model can simplify the management, for the "list party" empowerment and incentives to improve the R & D efforts to invest.

3.2. Dynamic "Milestone" Model Analysis

Under the dynamic "milestone" governance model, the "list issuer" conducts "milestone" assessment and phased funding for multiple "list issuers" participating in parallel competitions, i.e., the completion of project tasks will be assessed at fixed intervals (usually more than one year) after project initiation. Under the dynamic "milestone" governance model, the "list issuer" implements "milestone" assessment and phased funding for multiple "list issuers" participating in parallel competition, i.e., the completion of project tasks will be assessed at fixed intervals (usually more than one year) after the project has been initiated. For those who have passed the "milestone" assessment, the next stage of funding will be allocated; those who fail to pass the "milestone" assessment will be eliminated from the competition. Therefore, the dynamic game between the "list issuer" and the "list-

revealer", especially multiple "list-revealers", constitutes a cross-period dynamic game. In this paper, we further introduce the "milestone" assessment on the basis of the static tournament model and introduce k to measure the R&D gap between the "list-revealers".[17] In order to simplify the analysis, the dynamic game is analyzed in this paper. In order to simplify the analysis, this paper simplifies the dynamic "milestone" governance into a two-stage game, i.e., the "list issuer" only implements a "milestone" assessment on the "list-revealer" once, and the "milestone" assessment on the "list-revealer" once, and the "milestone" assessment on the "list-revealer" once. Milestone" assessment, and consider two "list-revealing parties" N_1 and N_2 Parallel competition between the two "list-revealing parties" and the "list-exposing party" involved in the "list-expanding party" scientific and technological research.

In the first phase of the dynamic "milestone" governance model, the "list revealer" N_1 and N_2 choose their optimal effort inputs and produce their own observable outputs y1 and y2 respectively. At fixed intervals (e.g., after 1 year) after the project is launched, the "list issuer" conducts a "milestone" assessment in conjunction with the project's demand unit or assessment unit and returns the results and relevant information to the "list issuer". The "list issuer" will jointly conduct "milestone" assessment with the project demand unit or assessment unit, and feedback the assessment results and related information to the "list revealer". At this time, the "list issuer" N_1 and N_2 face three results: all pass, one passes and one is eliminated, and none passes the assessment. In view of the relative simplicity of the follow-up governance of the latter two results, this paper focuses on the first result for in-depth analysis.

N_1 and N_2 After both pass the stage assessment, it is assumed that N_1 that the R&D results are ahead of N_2 The performance feedback from the government or "list maker" makes it possible for the Performance feedback from the government or the "listener" makes the N_1 and N_2 understand each other's R&D status and the R&D gap between them in the first stagek.

R&D Phase II, if N_2 To win the competition, the quality of its R&D output in the second phase must exceed the quality of the R&D gap k. N_1 The expected utility of competitor t, assuming that the stage funding available to the revealer after passing the "milestone" test, is $EU_t = EI_t - C(a_t)$ = $p_t M + (1 - p_t)\mathrm{m} - \frac{1}{2}ca_t^2$ where $c > 0$ is = , where. The expected utility of competitor t is =, where. $\frac{\partial EU_t}{\partial a_t}$ = $\frac{\partial p_t}{\partial a_t}(M - m) - ca_t = 0$, we obtain the competitor's optimal level of effort, i.e., the purely strategic Nash equilibrium level of effort input:

$$a_t = \frac{(\mathrm{M}-\mathrm{m})}{c} * \frac{\partial p_t}{\partial a_t} \tag{3}$$

When the superior competitor N_1 wins, then the N_1 outcome output must be greater than N_2 that is $y_1 > y_2 + k, \theta a_1 + \varepsilon_1 > \theta a_2 + \varepsilon_2 + k$, at which point $\varepsilon_1 - \varepsilon_2 > \theta a_2 - \theta a_1 + k$. Similarly, it follows that when the inferior competitor N_2 wins, there is $\varepsilon_2 - \varepsilon_1 > \theta a_1 - \theta a_2 - k$ the inferior competitor wins, there is a Letz $= \varepsilon_i - \varepsilon_j$, since the random variables ε_i , the ε_j are independent, the $\varepsilon_i - \varepsilon_j$ the density function is:

$$f_{\varepsilon_j - \varepsilon_i} = \begin{cases} \frac{z+2q}{4q^2}, & -2q \le z \le 0, \\ \frac{2q-z}{4q^2}, & 0 < z \le 2q \end{cases} \tag{4}$$

which in turn yields its probability function as:

$$F_{\varepsilon_i-\varepsilon_j}(z)=\begin{cases}\frac{1}{2}+\frac{z}{2q}+\frac{z^2}{8q^2}, -2q\le z\le 0\\ \frac{1}{2}+\frac{z}{2q}-\frac{z^2}{8q^2}, 0<z\le 2q\end{cases} \tag{5}$$

The probability distribution of z is known and is given by equation (5):

$$\begin{aligned}p_1(a_1,a_2,k)&=F(2q)-F(\theta a_2-\theta a_1+k)\\&=\frac{1}{2}-\frac{(\theta a_2-\theta a_1+k)}{2q}+\frac{(\theta a_2-\theta a_1+k)^2}{8q^2}\end{aligned} \tag{6}$$

$$\begin{aligned}p_2(a_1,a_2,k)&=F(2q)-F(\theta a_1-\theta a_2-k)\\&=\frac{1}{2}-\frac{(\theta a_1-\theta a_2-k)}{2q}+\frac{(\theta a_1-\theta a_2-k)^2}{8q^2}\end{aligned} \tag{7}$$

By combining equations (6) and (7) respectively fora_1 ,a_2 Derivation can be obtained:

$$\frac{\partial p_1}{\partial a_1}=\theta*[\frac{1}{2q}-\frac{(\theta a_2-\theta a_1+k)}{4q^2}] \tag{8}$$

$$\frac{\partial p_2}{\partial a_2}=\theta*[\frac{1}{2q}-\frac{(\theta a_1-\theta a_2-k)}{4q^2}] \tag{9}$$

When$k>0$ When, due to$a_1=a_2$, which can be obtained from equations (8) and (9):

$$a_1^*=a_2^*=\left[\frac{1}{2q}-\frac{k}{4q^2}\right]*\frac{(M-m)\theta}{c} \tag{10}$$

Dynamic "milestone" governance model with "revealer" effort input level and R&D gap k, effort input cost coefficient c, payoff differential (M-m), effort input observability, and output volatility.θ and the volatility of outputs$q$ and the volatility of outputs. It is important to note that despite theN_1 having an advantage, in equilibrium, theN_1 andN_2 both choose the same level of effort. In view of the fact that the dynamic "milestone" governance model adopts nodal assessment and the elimination of the fittest, the government or the "list issuer" can make clear the R&D progress and milestones of the "list-revealer" through nodal assessment, so it is suitable for projects with a high degree of complexity, a long project cycle (one to three years) and a long project period (one to three years). Achievements, so it is suitable for projects with a higher degree of complexity, longer project cycle (1 year to 3 years) and can be divided into typical stages of the list of projects. For example, in the project "Randomized, double-blind, single-simulation, multi-center validation clinical trial to evaluate the efficacy and safety of Jinchai capsule for the treatment of common cold (wind-heat syndrome) using placebo as a parallel control" in the Notice of Shijiazhuang Municipal Science and Technology Bureau on the release of the 2023 Biomedicine "Unveiling the List of Commendable Scientific and Technological Projects", it is clearly stipulated that the project shall be launched. "The project of "randomized, double-blind, single-simulation, multi-center validation clinical trial to

evaluate the efficacy and safety of Jinchai capsule in the treatment of common cold (wind fever) with placebo as parallel control" in the Notice clearly stipulates the specific timeframe for the initiation of the clinical trial, the enrollment of subjects and the analysis of the trial, which is typical of a staged approach and suitable for the application of the dynamic milestone governance model. However, as in the case of the static tournament governance model, the Government or the "list issuer" is still faced with the challenge of how to accurately set the amount of the list.

3.3. Analysis of the Ex Post Bidding Model

"Under the governance mode of ex post facto bidding, the "list-issuing party" announces the R&D project in advance, stipulates the R&D period, project start-up funds and the rules of the R&D competition; several "list-issuing parties Multiple "listed parties" choose their own optimal effort input to start the competition, the project does not carry out stage assessment; R & D activities expire, "listed parties" will report the results of the research and their own offer to the "listed party", "listed party" will report the results to the "listed party", "listed party" will report the results to the "listed party". The "list issuer" will consider the quality of the results and the offer of the list issuer to determine the final winner and pay the project bonus. In order to simplify the analysis, this paper assumes that two homogeneous and risk-neutral unveiling subjects participate in the "unveiling of the list of commanders" parallel competition, independently carry out innovation research and achieve results. After the expiration of the R&D activities, the two listed subjects participating in the parallel competition of "unveiling the list of commanders" make an independent closed-end offer for their own results, assuming that$y_i > y_j$ and$p_j = m$ The equilibrium bidding of the "list revealer" is as follows.i The equilibrium bidding is as follows:

$$p_i = \begin{cases} m + (y_i - y_j) & y_i - y_j \le \Delta \\ m + \Delta & y_i - y_j > \Delta \end{cases} \tag{11}$$

of whichp_i on behalf of the "list opener"i the auction price of R&D results set by$\Delta = M - m$. Assume that$y_i - p_i > y_j - p_j$, then the "list maker"i receives a prize of$i$ The offer is made. Therefore, the "revealer"i gets the prize:

$$\begin{cases} m + \theta(a_i - a_j) - z & \theta(a_i - a_j) - \Delta \le z < \theta(a_i - a_j) \\ m + \Delta & z < \theta(a_i - a_j) - \Delta \end{cases} \tag{12}$$

From this it follows that the$i$ The gain of is:

$$\int_{\theta(a_i - a_j) - \Delta}^{\theta(a_i - a_j)} [m + \theta(a_i - a_j) - z] f(z)\, dz + \int_{-\infty}^{\theta(a_i - a_j) - \Delta} (m + \Delta) f(z) dz - \frac{1}{2} c a_i^2 \tag{13}$$

Similarly, the gain of the "revealing party" j is:

$$\int_{\theta(a_i - a_j)}^{\theta\theta(a_i - a_j) + \Delta} [m + \theta(a_i - a_j) + z] f(z)\, dz + \int_{\theta(a_i - a_j) - \Delta}^{\infty} (m + \Delta) f(z) dz - \frac{1}{2} c a_i^2 \tag{14}$$

This can be obtained by taking the derivatives of equations (13) and (14) and making them equal to zero:

$$mf\left(\theta(a_i - a_j)\right) + \left[F\left(\theta(a_i - a_j)\right) - F(\theta(a_i - a_j) - \Delta\ )\right] = ca_i$$
$$mf\left(\theta(a_i - a_j)\right) - \left[F\left(\theta(a_i - a_j)\right) - F(\theta(a_i - a_j) - \Delta\ )\right] = ca_j \quad (15)$$

Since the unveiled units are homogeneous competitors among themselves, the unveiled units have the same level of effort input, i.e., equation (16) must satisfy$a_i = a_j$, since$F(-\Delta) = 1 - \mathrm{F}(\Delta)$, and$F(0) = \frac{1}{2}$, can be derived:$mf(0) + \left[F(\Delta) - \frac{1}{2}\right] = c\mathrm{a_i}$, the equilibrium effort input level can be obtained finally:

$$a^* = \frac{1}{\mathrm{c}}(\frac{\mathrm{m}+\Delta}{2\mathrm{q}} - \frac{\Delta^2}{8\mathrm{q}^2}\ ) \quad (16)$$

Under the ex-post competitive bidding governance model, the level of effort input by the "revealer" is related to factors such as the remuneration payment differential (M-m) cost coefficient c and the volatility of outputs, and the degree of observability of R&D results no longer affects the level of effort input by the "revealer".θ The degree of observability of R&D results no longer affects the level of effort of the "revealer". In addition, the ex-post bidding governance model combines the auction mechanism into the existing governance model, which no longer sets a fixed list amount but determines the final bounty through the offer of the "revealer" after the completion of the research and development, thus avoiding the difficulty of setting a precise list amount.

In equilibrium, the optimal bidding strategy can truly reflect the private information of the participants, and thus does not generate information rents.[18] The optimal bidding strategy can truly reflect the private information of the participants, and thus does not bring information rent, thus mobilizing the participation of the "list-revealer" and avoiding the emergence of opportunism. Therefore, the ex-post bidding governance model is suitable for projects in which the government or the "listing party" cannot accurately estimate the R&D costs due to the difficulty of technological prediction.

For example, in the "2022 Wuxi City "Taihu Lake Light" Science and Technology Research Program "unveil the list of marshal" projects (high-end chips and artificial intelligence) to be released in the list list list", "for the chip three-dimensional integration of wafer-level hybrid bonding technology research", "gallium nitride intelligent power module", "PCIE3.0 switching chip research and development" and other six projects are not given a fixed list. Bonding technology research", "gallium nitride intelligent power module research and development", "PCIE3.0 switching chip research and development" and other six projects are not given a fixed list amount, but the use of capped but not fixed form. For such projects, the use of ex post facto bidding governance model can realize the unity and self-consistency of incentivizing the "list-revealing party" to put in a high level of effort and avoiding its opportunism.

4. EXAMPLE ANALYSIS

In order to further compare the level of effort of the "revealer" under different governance modes of parallel competition among multiple actors in "revealer", this paper gives an example analysis of the equilibrium level of effort of the "revealer" under different stochastic perturbation factors. This paper gives an example analysis of the equilibrium effort level of the "revealer" under different stochastic

perturbation factors. Referring to the existing literature[19] In this paper, we assign values to the following parameters: winner's payoff M = 2.04, loser's payoff m = 0.54, cost coefficient c = 0.0002, effort observability levelθ = 0.4, 0.5, 0.6, 0.7, the number of "list-revealers" n = 2, and the stochastic perturbation factor q = (10, 60), and the equilibrium effort level of "list-revealers" under different stochastic perturbation factors are calculated, where a1 , a2 , a3 denote the static "tournament mode", the dynamic "milestone" mode, and the dynamic "tournament mode", and the dynamic "milestone" mode, respectively. where a , a , and a denote the level of effort of the "revealer" in the static tournament mode, the dynamic "milestone" mode, and the post-bidding mode, respectively.

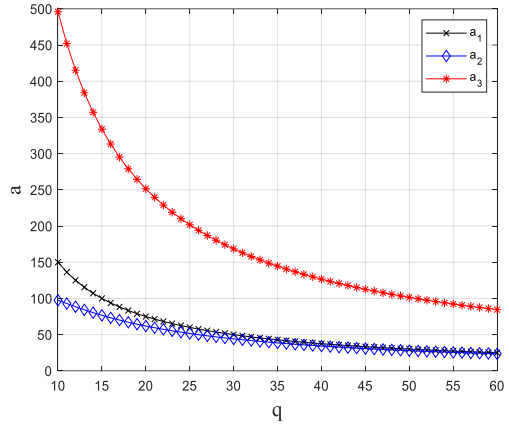

Figure 1. Levels of effort inputs by "list-revealing parties" (θ = 0.4)

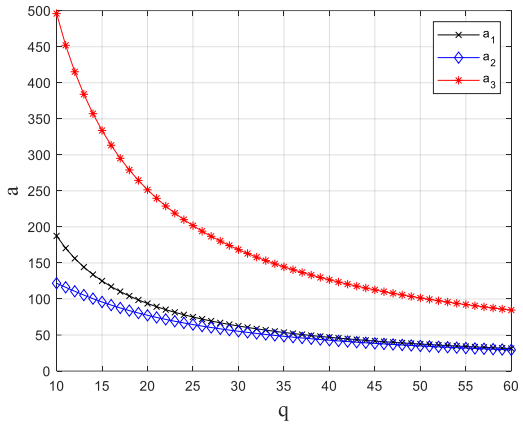

Figure 2. Levels of effort inputs by "list-revealing parties" (θ = 0.5)

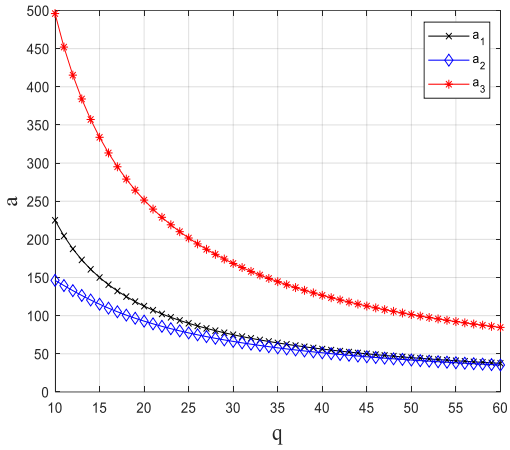

Figure 3. Levels of effort inputs by "list-revealing parties" (θ = 0.6)

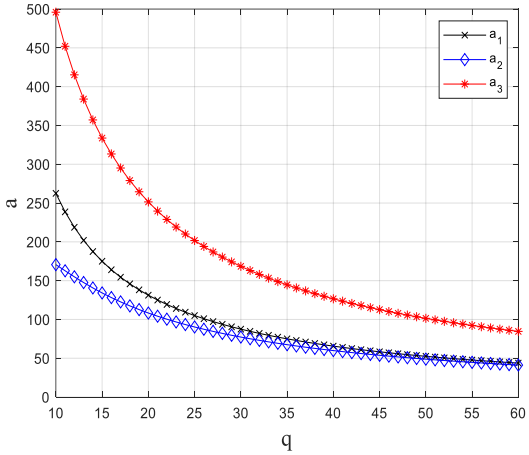

Figure 4. Levels of effort inputs by "list-revealers" (θ = 0.7)

Figures 1 and 2 show that as the stochastic perturbation factor increases, the effort level of the "revealer" under all three governance models tends to decrease. This means that the greater the uncertainty of project R&D, i.e., the greater the difficulty of project R&D, the risk of R&D failure borne by the "revealer" increases, and in the reality of the existing "revealer" failure tolerance mechanism is not yet complete[20] Under the current situation where the existing mechanism for tolerating the failure of the "Listed Party" has not been perfected, the "Listed Party" will not be able to obtain any bonus compensation and policy compensation in case of R&D failure, resulting in the "Listed Party" not being able to put in a high level of effort in researching and developing the key core technologies. In addition, when the observability of the R&D results is low, the level of effort of the "revealer" under the three governance modes is as follows: ex-post bidding governance mode > static tournament governance mode > dynamic "milestone" governance mode, which indicates that the ex-post bidding governance mode is more effective due to its ex-post effective incentive features,

and that the "revealer" cannot invest high level of effort in key core technology research. This suggests that the ex-post bidding governance model is more effective due to its ex-post effective incentives and its ability to avoid opportunism.[21][22] This shows that the ex-post bidding governance model can motivate the "list-revealing party" to invest high level of effort to a greater extent due to its ex-post effective incentive characteristics and its unique advantage of being able to avoid the emergence of opportunism. At the same time, compared with the dynamic "milestone" governance model with node-by-node assessment, the "list-revealer" is often willing to put in a higher level of effort under the static tournament governance model without stage-by-stage assessment, which is consistent with the "list-revealer" governance model. This is in line with the direction of the "list leader" approach, which advocates a reduction in process management and a loosening of the burden on the "list leader".

Figures 3 and 4 show that when the degree of observability of the R&D results is high, the effort level of the "revealer" in the ex-post bidding governance model is still the highest, regardless of changes in the stochastic perturbation factor. When the random perturbation factor is small, the effort level of the "revealer" in the static tournament governance model is significantly higher than that in the dynamic "milestone" governance model, and as the random perturbation factor increases, the effort level of the "revealer" in the dynamic "milestone" governance model is significantly higher than that in the dynamic "milestone" governance model. With the increase of the stochastic disturbance factor, the effort level of the "revealer" in the dynamic "milestone" governance model gradually approaches that of the static tournament governance model. This suggests that the static tournament is suitable for projects with a high degree of observability and low R&D uncertainty, i.e., moderate project difficulty, while the dynamic milestone governance model is suitable for projects with a high degree of observability and high R&D uncertainty, i.e., projects with a high degree of complexity and difficulty, which is consistent with the previous analysis.

The results of the above example analysis show that, for different list projects, choosing the appropriate "list-exposing" parallel competition governance model can effectively incentivize the "list-exposing party" to increase its efforts and improve the efficiency of innovation and research.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion of the Study

The "list and commander-in-chief" of key core technologies is an important reform to promote a better combination of effective market and active government in the field of science and technology innovation, and to accelerate the realization of independent control of key core technologies and high-level scientific and technological self-reliance and self-improvement. On the basis of researching Sichuan and Chongqing science and technology authorities' scientific and technological research and combing through the policy texts of various provinces and cities, this paper further analyzes the parallel governance of multiple subjects in "unveiling the list" and analyzes the model of competitive governance. The study found that: (1) Combined with the amount of list setting and incentive mode selection, the governance mode of "unveiling the list of marshals" can be divided into three categories: static tournament mode, dynamic "milestone" mode, and after-the-fact bidding mode. (2) factors such as compensation payment gap, marginal R&D cost, volatility and observability of scientific research output affect the efforts of the "revealer" in the "revealer" multi-actor parallel competition governance model; (3) the "revealer" in the "revealer" multi-actor parallel competition governance model can be categorized as static tournament model, dynamic "milestone" model and ex-post bidding model. (3) The three types of governance models of "list-ranking" multi-actor parallel competition have their own application scenarios. Under the static tournament governance model, funds are allocated in a lump sum with no stage assessment, which is suitable for projects with clear project scope, relatively low difficulty and short cycle (less than 1 year), and high observability of R&D results. The dynamic

"milestone" governance mode adopts nodal assessment and elimination of the fittest, applicable to list projects with a higher degree of project complexity, longer cycle and typical phases. The ex post facto bidding governance model determines the final amount by introducing the quotation of the "list-revealing party" itself, so as to reasonably determine the amount of the list and avoid opportunistic behaviors, which is applicable to projects where the government and the "list-revealing party" are unable to accurately estimate the R&D costs due to the difficulty of technological prediction.

5.2. Policy Recommendations

The purpose of the "list of commanders" is to integrate and optimize the allocation of scientific and technological resources, widely gather advantageous research and development forces, and crack the "neck" problem in an organized and efficient manner. In order to optimize and improve the governance mechanism of the "list of commanders" for key core technology research, the following suggestions are made based on the findings of this paper:

First, improve the "list of commanders" out of the list mechanism. Closely focusing on the national strategic needs and the reality of local economic development technology bottlenecks, accelerate the formation of clear objectives, application-oriented, end-users clear key core technology research system and can be "milestone" assessment of the research tasks, "list" should be target The "list" should be clear, verifiable and appraisal, strengthen the end-users in the list and set the list of the right to speak, strong and orderly promotion of scientific and technological innovation and research, to avoid the "reveal the list of commanders" inefficient abuse.

Secondly, the organization and management of the "list of commanders" should be improved. According to the list of content and technology prospects, according to local conditions, reasonable choice of static tournament mode, dynamic "milestone" mode and after-the-fact bidding mode, such as "reveal the list of commanders" effective governance mode, an effective balance between results-oriented and process management, financial investment and cost-effectiveness, to promote the organic unity of scientific research exploration and industrial application. Promote the organic unification of scientific research exploration and industrial application. For parallel competition in which multiple technology routes are promoted in parallel, a due diligence exemption mechanism for failure in research and development is scientifically designed to effectively address concerns.

Thirdly, optimizing the incentive mechanism of "revealing the list of commanders". Continuously increase the key core technology research and development "list of commanders" financial investment, to guide more social funds to support the "list" project. Actively implement the technical master system, funding system, credit commitment system, build talent echelon support, scientific research conditions support, management mechanism support, etc., "listed and marshaled" the whole process of tracking services. Explore the systematic incentive mechanism combining moderate incentives and reputational incentives to create a good ecology for scientific and technological innovation.

REFERENCES

[1] ZENG Jingjing, HUANG Guihua, YAN Yupan. Characteristics of "list" and "marshal" and their matching in "unveiling the list and hanging the marshal"[J/OL]. Science Research:1-25[2023-04-12].

[2] CHEN Jin, ZHU Ziqin, YANG Shuo. The mechanism of "revealing the list of commanders": connotation, mode of implementation and practical exploration[J/OL]. Soft Science:1-14[2023-04-03].

[3] SI Linbo, MENG Ji, ZHANG Pan. The basic mode and practice situation of exploring and innovating the system of scientific and technological projects--A comparative analysis of multiple cases based on domestic practice[J]. China Science and Technology Forum,2022,No.315(07):12-22.

[4] Jingjing Zeng,Guihua Huang. The system of scientific and technological project unveiling: operation mechanism and key crux[J]. Science Research,2021,39(12):2191-2200+2252.

[5] Ms. Jingjing Zeng, Ms. Yongdan Shi, Ms. Guihua Huang. How to Generate Commander-in-Chief? --A Study on the Mechanism of "Selecting, Determining, and Hanging the Commander-in-Chief" in the System of Unveiling the Commander-in-Chief[J/OL]. Science and Technology Progress and Countermeasures:1-9[2023-04-03].

[6] Liu Haiyang, Guo Lu, Kong Xiangzhen. Incentives and Distortions under the Mechanism of Academic Championship--What Leads to High Quantity and Low Quality in Chinese Academia? [J]. Nankai Economic Research, 2012(01):3-18.

[7] Baba Ali Ernest, Radmehr Riza, Shayanmehr Samira, Gyamfi Bright Akwasi, P. Anufriev Valery. the role of technology innovation, R&D, and quality governance in pollution mitigation for EU economies: fresh evidence from method of moment quantile regression[J]. International Journal of Sustainable Development & World Ecology, 2023,30(3).

[8] Sylvia Breukers,Matthijs Hisschemöller,Eefje Cuppen,Roald Suurs. Analysing the past and exploring the future of sustainable biomass. Participatory stakeholder dialogue and technological innovation systems research[J]. Technological Forecasting & Social Change,2014,81(Jan.).

[9] ZHANG Xiaofang,MEN Zhuowu,LI Chufu. Research on rolling schedule planning for scientific research projects[J]. Research Management,2021,42(09):134-139.

[10] Kay L . The Effect of Inducement Prizes on Innovation: Evidence from the Ansari X Prize and the Northrop Grumman Lunar Lander Challenge[J]. Social Science Electronic Publishing, 2011, 41(4):360-377.

[11] Boudreau K J , Lakhani K R . "FIT": field expressive evolution on sorting, incentives and creative worker performance[J]. 2011.

[12] ZHANG Yuqiang,SUN Shuqiu. "Exposing the List of Commanders": Connotation Explanation, Practical Exploration and Innovative Development[J]. Economic System Reform,2021(06):13-19.

[13] Ye Xiangsong,Liu Jing. The impact of government support and marketization degree on scientific and technological progress in manufacturing industry[J]. Economic Research,2020,55(05):83-98.

[14] YANG Guochao,RUI Meng. Incentive effect and catering effect of tax relief policy for high-tech enterprises[J]. Economic Research,2020,55(09):174-191.

[15] CHEN Qiangyuan,LIN Sitong,ZHANG Qing. China's technological innovation incentives: incentivizing quantity or quality[J]. China Industrial Economy,2020(04):79-96.

[16] Chen H , Ham S H , Lim N . Designing Multiperson Tournaments with Asymmetric Contestants[J]. Management Science, 2011.

[17] Dukerich J , Weigelt K , Schotter A . A game theory analysis of dual discrimination[J]. Organizational Behavior & Human Decision Processes, 1990, 47(1):21-41.

[18] CHEN Zhijun,ZHANG Xinzhu. Research on Incentive Mechanisms of Scientific Research Funding-An Analytical Framework and Literature Review[J]. Economics(Quarterly),2004(04):1-26.

[19] Yan Wei,Luo Yuhe,Liu Zhiwei. A comparative study of tournament and auction incentives in innovation competitions:An experimental approach[J]. Economic Management,2012,34(03):133-143.

[20] SHA Dechun, HE Xinwei, XIAO Meidan. China's practice of unveiling and marshaling system for scientific research projects: process mechanism and optimization path[J]. Science Management Research,2022,40(03):59-68.

[21] Yeon-Koo Che,Ian Gale. Optimal Design of Research Contests[J]. The American Economic Review,2003,93(3).

[22] Richard, L, Fullerton, et al. Using Auctions to Reward Tournament Winners: Theory and Experimental Investigations[J]. Rand Journal of Economics, 2002.