

Article

Dynamic Mechanisms of R&D Innovation in Chinese Multinational Corporations: The Impact of Government Support, Market Competition and Entrepreneurial Spirit

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Abstract: This study focuses on the R&D innovation drive mechanism of Chinese multinational companies. Using a grounded theory, five driving factors were identified: government support, entrepreneurial spirit, market competition, company profits, and the innovation environment of the host country. Dynamic Qualitative Comparative Analysis was then employed to assess the validity of these driving factors and determine their pathways of influence, leading to the establishment of a driving mechanism. Finally, structural equation modeling was used to explore the magnitude of the effects of these driving factors. Based on data analysis from Chinese A-share listed multinational companies from 2007 to 2022, it was found that entrepreneurial spirit serves as the core driving force, while government support and market competition act as mediating variables that significantly promote R&D innovation among Chinese multinational companies. However, company profits were found to have a negative impact. Additionally, the innovation environment of the host country plays a moderating role, enhancing the positive effects of government support and market competition on innovation. These findings emphasize the importance of the synergy between the internal and external resources for Chinese multinational companies, providing important insights for integrating global resources to enhance international competitiveness and innovation capabilities.

Keywords: technological innovation; research and development; government support; market competition; entrepreneurial spirit; innovation dynamics; economic growth; technology management; Chinese multinational corporations



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1. Introduction

In the era of globalization and informatization, innovation has become the key factor driving the sustainable growth of enterprises and the enhancement of international competitiveness. As essential participants in the global economy, cultivating and enhancing innovation capabilities in Chinese multinational corporations are significant for realizing high-quality productivity [1]. However, in the *Global Innovation Index 2023* released by the World Intellectual Property Organization, the United States secured the top position across several key indicators, including global corporate R&D investment, the venture capital received, university quality, the comprehensive valuation of unicorn companies, and the concentration of the corporate intangible asset value. In contrast, China ranked only 12th in the overall index. From the perspective of Fortune Global 500 companies, China mainly focuses on energy industries, finance, real estate, and construction [2]. At the same time, the United States is dominated by finance and high-tech companies; Japan focuses on automobile manufacturing, electronic products, finance, and heavy machinery manufacturing; and Germany focuses on automobile manufacturing and finance [3]. In comparison, Chinese

multinational corporations have significant weaknesses in profitability, high-tech fields, and high-end service industries [4].

The deep-seated reason lies in China's insufficient driving force for innovation. In terms of R&D expenditure, although China ranked second globally in total R&D spending in 2023, second only to the United States, the proportion of R&D spending relative to GDP was only 2.65%. In comparison, the U.S. has maintained a ratio above 3% since 2019, indicating that Chinese companies still rely heavily on their traditional development models and lack enthusiasm for innovation. One possible reason is that although innovation can help companies improve productivity and enhance their ability to integrate into global networks [5], which is crucial for increasing the international competitiveness of Chinese multinational corporations, the innovation process involves high risks. In pursuing technological breakthroughs and upgrades, firms not only face the possibility of failure and challenges from internal conservative forces, but must also manage the uncertainties of R&D outcomes and the risks of technology leakage [6,7]. These factors can significantly weaken companies' motivation for R&D. Therefore, how to effectively promote research and development innovation in Chinese multinational companies, thereby enhancing their competitiveness in the international market, is an inevitable issue in the process of internationalization.

Some scholars have identified that multinational companies typically engage in R&D innovation for two main purposes [8,9]: first, to support and adapt overseas products, thereby improving company productivity and promoting increased export activities [10,11]; second, to conduct specialized research that leverages distance advantages and utilizes the host country's technologies and knowledge to enhance the diversity and complementarity of their technologies [12,13], while also escaping low-price competition in their home country [14]. From this, it can be observed that the primary goal of MNCs in pursuing innovation is to gain a larger competitive advantage. However, how MNCs can effectively utilize internal and external R&D innovation resources to transform them into innovative drive, thereby achieving a leap in the value chain through innovation, remains an area that requires further investigation. Additionally, there is still room for further research into the comprehensive effects of various factors. Therefore, this paper focuses on the research theme of the R&D innovation drive mechanism of Chinese multinational companies, examining the driving forces of R&D innovation from a holistic perspective.

Therefore, this study first identifies the driving factors through qualitative analysis. Then, the dynamic QCA method is employed to, on the one hand, verify the correctness of the identified factors, and on the other, explore the pathways through which these factors operate, thereby establishing a driving mechanism model. Finally, a structural equation model is used to test the significance of the driving mechanism's effects.

2. Identification of Factors of Motivational Mechanisms for Chinese Multinational Corporations

2.1. Method Selection for Identifying the Factors of Motivational Mechanism

To comprehensively grasp the essence and fundamental principles of technological research and development (R&D) innovation within Chinese multinational corporations (MNCs), a detailed and thorough investigation into their innovation behavior is imperative, particularly from the perspective of MNCs [15]. This entails the sources of motivation from the company's viewpoint and constructing a motivational mechanism model. Such an endeavor necessitates the utilization of qualitative research methods. This study adopts the grounded theory approach in qualitative research, a technique that seamlessly integrates text quantification research with theory construction, transcending the constraints of the pre-existing theories [16]. The grounded theory deeply explores the core concepts underpinning individual or organizational behavior within specific contexts, as evidenced in the literature [17,18]. By examining the intricate associations between innovation behavior and motivational factors, this approach effectively navigates the challenges posed by the dynamic and long-term nature of innovation behavior in research. In this study,

the procedural grounded theory serves as the primary research method, systematically extracting and condensing the core concepts from textual data through iterative, open coding, axial coding, and selective coding processes, thereby offering a robust framework for understanding and analyzing the motivational mechanisms driving R&D innovation in Chinese MNCs.

2.2. Identification Process of Motivational Mechanism

Since the grounded theory is an analysis method based on textual data, selecting accurate texts for analysis is particularly important. As this study focuses on the driving factors behind the R&D innovation of Chinese multinational companies, the mainstream literature search platforms were used to ensure the inclusion of relevant domestic and international studies. The chosen platforms include CNKI, Google Scholar, and Web of Science. The search keywords were related to “R&D innovation drivers of multinational companies”, ranging from broad to specific terms. The specific keywords used included “R&D innovation”, “innovation drivers”, “multinational company innovation”, “R&D by Chinese multinational companies”, and “innovation drive mechanism”. The search results included not only academic papers, but also news reports and institutional survey reports. However, given the focus of this study on the innovation drivers of multinational companies, irrelevant content, such as personal profiles and product advertisements, was excluded. Additionally, literature unrelated to innovation drivers, such as “R&D audits” or “innovative instruments”, was removed. To ensure the credibility of the texts, only publications indexed in the CSSCI (Chinese Social Sciences Citation Index), the Chinese Science Citation Database, and the journal ranking list from the Chinese Academy of Sciences Literature and Information Center were retained. Ultimately, 985 texts were selected as research samples for grounded theory analysis.

2.2.1. Open Coding

Open coding involves coding and naming text documents and primary materials line by line and sentence by sentence to identify and define relevant concepts and information reflected in the data. Subsequently, the initially coded concepts are reorganized and grouped to form categorized information. This study imported 985 texts related to the technological innovation of multinational corporations into NVivo 12 software and manually classified them into 62 categories. This systematic approach not only streamlines the data analysis process, but also enhances the depth and richness of insights derived from an extensive literature review, thereby laying a solid foundation for the subsequent phases of research.

Table 1 is an excerpt from an open coding process commonly used in qualitative research to categorize and interpret data. Each row in the table is identified by a number, where the first digit likely indicates the group or category, and the second digit represents the sequence of statements within that group. The “Original Statement” column contains raw data or original statements from the research participants or sources. The “Concept Extraction” column shows the initial interpretation or summarization of the original statement, capturing its essence in a more concise form. The “Effective Concepts” column includes the final, refined concepts derived from the concept extraction process, representing the key themes or ideas for further analysis. For example, entry 1-1’s original statement about the market attractiveness of innovative products highlights the need for substantial market demand with purchasing power, leading to the practical concept of “Market effective demand”. Entry 1-2 emphasizes the decisive role of technological innovation talent in corporate innovation, distilled into the idea of “Technological innovation talent”. The first instance of entry 2-1 asserts that substantial profits drive the diffusion of innovative products, captured as “Market profit-oriented”. The second instance of entries 2-1 focuses on how technological development spurs companies to organize and commercialize innovative activities, summarized as “Technological progress-driven”. These concepts

collectively underline the importance of market demand, skilled talent, profit incentives, and technological advancements in driving innovation.

Table 1. Excerpt of open coding.

Number	Original Statement	Concept Extraction	Effective Concepts
1-1	The market attractiveness of innovative products is the actual demand attraction or payment ability demand that drives their diffusion in the market.	Innovative products need market demand with payment ability.	Market effective demand
1-2	High-level technological innovation talent cultivation also plays a decisive role in corporate technological innovation, whether it is mastering technical knowledge or understanding possible ways of using and improving technology; it is reflected in the hands of people who develop these technologies and promote their application.	Technological innovation talent plays a decisive role in corporate innovation.	Technological innovation talent
...	...	...	...
2-1	Innovative products can directly obtain considerable profits in the product market as a commodity. Substantial profit is the primary driving force for the diffusion of innovative products.	Innovative products will only be diffused when they can obtain substantial profits.	Market profit-oriented
2-1	Technological development drives technological innovation through various channels to generate new technological ideas, which often induce entrepreneurs to organize technological innovation activities and commercialize technological innovation results.	Technological development drives companies to organize innovative activities.	Technological progress-driven
...	...	...	...

Note: 1-1 refers to the first initial code of the first research text, and so on.

2.2.2. Axial Coding

Axial coding, often called core coding, represents a pivotal phase in qualitative data analysis that builds upon the foundational work of open coding [19]. This advanced analytical technique involves the systematic and in-depth examination of the initial categories identified during open coding, focusing on understanding the relationships and connections between these categories to derive more profound insights [20]. By exploring the inter-relationships among the coded data segments, axial coding aims to synthesize and integrate the fragmented concepts into coherent and overarching themes or significant categories [21].

Table 2 summarizes the axial coding results, refining the initial codes into six main categories with interpretive explanations. Government support includes financial support (direct financial aid through various mechanisms) and Research and Innovation Platforms (government-backed structures promoting scientific research). The host country's innovation environment covers the Technological Level of the Host Country (technological capabilities and infrastructure) and Knowledge Barriers in the Host Country (barriers like intellectual property protection). Entrepreneurial spirit comprises entrepreneurial innovation spirit (awareness of innovation importance) and an Entrepreneurial Decision-Making Ability (responding to market changes). Market Competition involves Market Share Competition (international sales competition) and Cost Competition (importance of production costs). company profits include the Current Profits (net earnings) and the Expected Profits (future profit projections). Finally, technological R&D innovation behavior consists of Technical Research (exploration of technology) and technology development (transforming research into marketable innovations).

Table 2. Results of axial coding.

Main Category	Initial Category	Interpretation
Government Support	Financial Support	The government may provide direct financial support to companies through various forms, such as innovation funds and technology development plans, including R&D subsidies, tax incentives, and technology project funding.
	Research and Innovation Platforms	Refers to organizational structures or institutions established and supported by the government to promote scientific research and technological innovation. This includes national laboratories, technology industry clusters, incubators, accelerators, etc.
Host Country Innovation Environment	Technological Level of Host Country	Refers to the technological level and technical strength faced by Chinese companies in their target host countries, including technological infrastructure, industrial–technological levels, etc.
	Knowledge Barriers in Host Country	This refers to the technological barriers that Chinese multinational companies face in certain aspects of local markets or industries, including intellectual property protection, industry entry barriers, etc.
Entrepreneurial Spirit	Entrepreneurial Innovation Spirit	Refers to the high awareness and sensitivity of Chinese multinational companies to innovation, the ability to perceive market changes and opportunities, and the recognition of the importance of technological R&D innovation for company development.
	Entrepreneurial Decision-Making Ability	Refers to the ability of entrepreneurs to respond to market changes and technological developments, thereby promoting the ability to innovate in technological R&D.
Market Competition	Market Share Competition	Refers to the competition of companies in the international market to seize and maintain sales shares of products or services.
	Cost Competition	Refers to the production and procurement costs becoming an important factor in the competition of Chinese companies in the process of globalization development.
Company Profit	Current Profits	Refers to the net amount obtained by the company through its business activities within a specific accounting period (usually one year), deducted from the total costs and expenses. It is an important indicator for the company's decision-making.
	Expected Profits	Refers to the company's estimate or expectation of future profits based on its business plan for innovative products and market expectations over a period in the future.
R&D Innovation Behavior	Research	Refers to in-depth exploration and investigation in the field of technology, including research on new technologies, methods, materials, etc.
	Development	Refers to the process of transforming scientific knowledge into new or improved products, processes, or services.

2.2.3. Selective Coding and Model Construction

Selective coding represents a critical phase in qualitative data analysis. The focus shifts towards distilling the core categories from the main categories identified during axial coding, aiming to create a cohesive and comprehensive theoretical framework [22]. Through conceptualization, selective coding clarifies the relationships between these core categories and other identified categories, ultimately striving to develop a universally applicable theoretical model [23]. In the context of technological innovation within Chinese multinational corporations, the six main categories identified highlight vital influencers, such as government support, the innovation environment in the host country, entrepreneurial drive, market dynamics, and company profitability [24]. Government support and the regulatory frameworks play a pivotal role in fostering an innovation-friendly climate, while internal entrepreneurial spirit fuels the actualization of innovative ideas. Market competition catalyzes continuous innovation efforts, and the level of company profitability is a sustainable incentive for innovation endeavors [25]. When these factors synergize within a host country's conducive innovation environment, they collectively propel technological

innovation within Chinese multinational corporations on a global scale, underscoring the intricate interplay of diverse elements in driving innovation excellence [26].

By plotting the various dynamic factors in Figure 1, it can be observed that the model identifies five key drivers of innovation: entrepreneurial innovation spirit (company culture encouraging risk-taking and new ideas), the company profile (including size, age, and the industry sector), government support (financial incentives, tax breaks, and policies promoting innovation), the innovation environment (ecosystem supporting innovation, such as research institutions, universities, and skilled workers), and market competition (level of competition in domestic and international markets). These drivers influence five critical areas essential for technological innovation: innovation push (internal drive for innovation), innovation sustainability (ability to continue innovating over time), the innovation environment (external factors creating an enabling environment), innovation resources (financial, human, and technological resources for innovation), and innovation perception (company's view on innovation's importance). The model indicates that these five areas collectively influence technological research and development (R&D), which is the engine of technological innovation in Chinese MNCs.

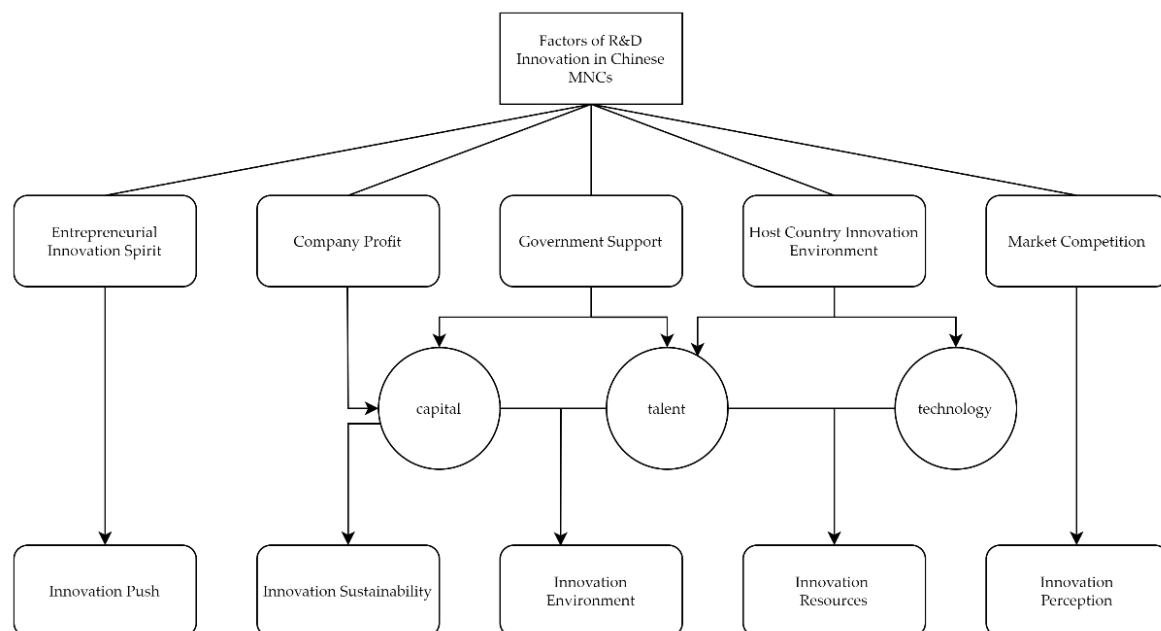


Figure 1. Mechanism factors of R&D innovation in Chinese multinational corporations.

2.3. Interpretation of the Mechanism Factors of Dynamic Forces in Chinese Multinational Corporations

2.3.1. External Driving Force: Government Support

The government intervention theory states that governmental involvement can effectively rectify market failures and incentivize companies to prioritize long-term research and development (R&D) and innovation initiatives [27]. An innovation-friendly ecosystem can be cultivated by strategically designing and optimizing government systems, thereby stimulating greater engagement from multinational corporations in innovation endeavors. The Chinese government, aware of this principle, has implemented a spectrum of policies to bolster the innovation landscape for multinational corporations, primarily focusing on fostering technological advancement and strengthening their competitive edge [28]. Through a suite of mechanisms, such as subsidies, rewards, and financial backing, companies are incentivized to ramp up their R&D investments. Various supportive measures are extended to companies to bolster their financial resources, including tax incentives for innovative entities, the deductibility of R&D expenditures, R&D subsidies, science and technology funds, and tax relief schemes [29–31].

Furthermore, establishing innovation hubs, like national key laboratories and engineering technology research centers, equip companies with cutting-edge R&D infrastructure and technical assistance. Initiatives like talent plans and projects are introduced to elevate companies' innovation capabilities by attracting and nurturing skilled professionals [32]. The Chinese government steers companies towards investing in innovation within strategic emerging sectors through strategic industrial policies, thereby fortifying their global industrial positioning [33]. Concurrently, financial institutions are encouraged to provide technology-focused financial services to facilitate corporate financing and alleviate funding challenges for technology-driven enterprises, collectively fostering a conducive environment for innovation and technological advancement within Chinese multinational corporations [34].

2.3.2. External Pulling Force: Host Country's Innovation Environment

In the context of the globalization journey undertaken by Chinese multinational corporations, the advanced innovation ecosystems prevalent in host countries have presented significant opportunities and intensified competitive pressures [35]. This evolving landscape of technological progress catalyzes multinational corporations to sustain their edge in technological research and development (R&D). Under the catalysis of the host country's innovation environment, Chinese multinational corporations (MNCs) continuously innovate to better adapt to technological changes [36], ensuring the stability of their core competitiveness. At the same time, the continuous innovation efforts of MNCs drive the establishment of global R&D networks, thereby enhancing their access to global R&D resources [28]. This enables companies to better leverage the diverse innovation resources and talent pools within the host country's innovation environment, further stimulating innovation and expanding the scope of R&D [37]. Therefore, the host country's innovation environment helps Chinese MNCs secure support from global collaboration frameworks, promoting technological advancement through international cooperation [38].

2.3.3. Internal Pulling Force: Entrepreneurial Spirit

Entrepreneurial spirit emphasizes innovation, risk-taking, and adaptability to change, which is crucial for areas requiring continuous experimentation and improvement, such as technological R&D. The influence of entrepreneurial spirit on technological R&D innovation in Chinese multinational corporations is comprehensive. This drives the motivation for innovation, the establishment of innovative cultures, and the adaptability of organizations to change [39]. This helps multinational corporations maintain competitiveness globally, continuously promoting the progress of technological R&D [40].

In technological R&D, the embodiment of entrepreneurial spirit manifests as the restless pursuit of progress, the constant questioning of the status quo, and the tireless exploration of novel technological pathways and solutions. Often, new business opportunities emerge from the interplay of shifting market demands, technological breakthroughs, and industry trends [41]. While technological R&D inherently involves navigating uncharted territories and facing unknown challenges, entrepreneurial spirit equips organizations with the resilience to embrace uncertainty and adapt to changes in technological directions and market requirements [42]. This entrepreneurial mindset fosters a learning culture that celebrates failure as an opportunity for growth, recognizing that missteps can help identify problems and uncover innovative solutions, providing a more precise roadmap for future R&D endeavors. In summary, entrepreneurial spirit plays the key role in the technological R&D innovation of Chinese multinational corporations. This not only stimulates the motivation for innovation, but also promotes the establishment of an innovative culture and improves the adaptability of organizations to change.

2.3.4. External Driving Force: Market Competition

Competitive-driven innovation can be understood from several aspects: In a fiercely competitive market, multinational corporations are in a complex system. Factors such as

market demand, competitive situation, technological investment, and product performance interact to form a dynamic equilibrium system [43]. Market share is one of the key variables in the system, which is influenced by product performance, innovation investment, and competitors [44]. Changes in market share will have feedback effects on the company's innovation strategy, thereby affecting the input and output of technological R&D [45]. The speed and depth of technological innovation are the key factors in the system, influenced by competitive pressure and market demand. When competition intensifies, companies may increase investment in technological R&D to seek a competitive advantage in the market. This competitive-driven paradigm often ushers companies through cyclical phases of innovation and adjustment, where strategic recalibrations are essential for staying ahead in the competitive landscape. In an environment characterized by the perpetual evolution of competition, multinational corporations must uphold a culture of flexibility and adaptability in their technological R&D and innovation endeavors to navigate the ever-shifting terrain of global markets and sustain their competitive prowess amidst dynamic industry forces [46,47].

2.3.5. Internal Driving Force: Company Profit

Profit indicators are the fundamental metrics that significantly influence companies' operational trajectory and growth, directly impacting their sustainability, development, and fulfillment of social responsibilities. Companies rely on the reasonable evaluation of both current profitability and the anticipated future earnings to make informed decisions regarding their engagement in innovation endeavors. Innovation often requires significant financial and resource investment, and these investments may not be immediately reflected in the profit and loss statements. Therefore, companies need a clear understanding of the future profit potential to make decisions that align with long-term strategies during the current period. In a fiercely competitive and rapidly changing market environment, the comprehensive consideration of profit indicators helps companies find a balance point, achieving short-term profitability while providing necessary resources for future innovation and development [48–50].

3. Establishment of Chinese Multinational Corporations' Dynamic Mechanism

Based on the conclusions derived from grounded theory research, this chapter focuses on verifying the correctness of the identified driving factors and analyzes how these dynamic factors combine to influence the technological innovation behavior of Chinese multinational corporations, thereby answering core questions, such as how to utilize existing resources to achieve high-quality development. In line with the research purpose, this chapter adopts the Qualitative Comparative Analysis (QCA) method proposed by sociologist Charles Ragin, which represents a new approach combining qualitative and quantitative research [51]. QCA does not assume independence among independent variables; instead, it relies on Boolean algebra and a set theory to analyze the sufficient and necessary relationships between multiple conditions and outcomes, providing a configurational perspective to explain complex social phenomena [52]. Considering that technological innovation by Chinese multinational corporations is a dynamic and continuous process and the participation and input of innovation subjects have delayed effects on corporate innovation behavior, this study employs a dynamic QCA method and utilizes R language for panel data analysis to explore the factors influencing the innovation behavior of Chinese multinational corporations and their changes over time [53]. Section 3.1 focuses on the selection and calibration of the data required for dynamic QCA analysis, serving as the foundation for data analysis. Then, in Section 3.2, necessity and sufficiency tests are conducted to analyze the accuracy of each driving factor and the combined effect paths, thereby establishing the driving mechanism model for Chinese multinational companies.

3.1. Sample Selection and Variable Selection

The selection of research objects mainly comes from the Zephyr Overseas Mergers and Acquisitions Database and the FDI Market Database. Zephyr, provided by Bureau van Dijk, focuses on global mergers and acquisitions (M and A), private equity, venture capital transactions, and IPOs. The FDI Markets Database, managed by the Financial Times Group, provides real-time statistics on global greenfield foreign direct investment (FDI) projects. By combining the data from these two databases, it becomes possible to integrate both M and A and direct investment data globally, thus ensuring that all Chinese multinational companies are comprehensively included in this study. Considering the significant changes in the accounting treatment of R&D expenditures following the implementation of the new accounting standards in 2007, the data from the Zephyr and FDI databases were integrated using the unique identifier “Event ID”. After integration, the company names corresponding to each Event ID were matched with Chinese A-share listed companies. If multiple Event IDs corresponded to the same company, the event with the earliest occurrence was selected to ensure that all the multinational investment events were included. Since dynamic QCA requires balanced panel data [54], the sample selection covered Chinese A-share listed companies from 2007 to 2022. Ultimately, 74 multinational companies were selected, yielding a dataset of 1184 observations, meeting the sample size requirements for QCA research. The financial data for the A-share listed companies were sourced from the CSMAR database. The full name of CSMAR is China Stock Market and Accounting Research; this provides comprehensive financial data covering Chinese companies, making it suitable for studying the R&D innovation behavior and driving factors of Chinese multinational corporations. The preliminary analysis of this research sample reveals that in terms of industry distribution, the sample covers fisheries, mining, manufacturing, and services, with manufacturing MNCs being the most numerous, totaling 50 companies, primarily in the computer, communication, and other electronic equipment manufacturing industries. Additionally, 20 companies are engaged in services, 3 in mining, and 1 in fishing. The selection of these samples is based on two main factors: (1) Their R&D activities span from 2007 to 2022, providing relatively complete data on multinational R&D activities. (2) Manufacturing and services better reflect innovation-driven behavior, and including resource-dependent industries like fisheries and mining allows for a more comprehensive understanding of the driving factors behind R&D innovation under different models. In terms of international development, the research sample shows investments distributed across 41 countries or regions, covering all the seven continents. The United States has the highest number of investments, with 29 companies, followed by Singapore (15 companies) and Japan (14 companies), with the rest scattered across various regions worldwide. This sample thus covers major international markets, enabling a more comprehensive study of the driving forces behind the innovation of Chinese multinational corporations.

Table 3 presents the selected variables used to analyze technological R&D innovation behavior within companies, categorized by variable type and their computation method. The dependent variable is R&D innovation behavior (IB), as the occurrence of such activities is typically accompanied by R&D investment. Considering the lagging effect of the driving factors, calculation is performed using the ratio of the company’s R&D expenditures to its lagged operating revenue. The independent variables include the following: Government support (GS), measured as government innovation subsidy funds divided by total assets, reflects the role of government incentives. The host country’s innovation environment (IE), averaged from the host country’s *innovation index rankings*, highlights the external support for innovation. The higher the ranking is, the weaker the country’s innovation capability is, so a lower value is better; these data come from the World Intellectual Property Organization. Entrepreneurial innovation spirit (IS), which is the natural logarithm of domestic and foreign patent applications, shows the internal drive for innovation. Market competition (MC), calculated as one minus the Herfindahl Index adjusted by the company’s performance, indicates competitive pressures. Company profits (CPs), which are the change in net profit from the previous year, show the link between financial health and innovation

investment. This table systematically organizes these variables to assess their impact on technological R&D innovation behavior, offering a comprehensive view of the factors influencing this behavior.

Table 3. Variable names and computation methods.

Variable Category	Variable Name	Variable Symbol	Calculation Method
Dependent Variable	R&D Innovation Behavior	IB	R&D expenditure of the company/lagged one period of the company's operating income
Independent Variables	Government Support	GS	Government innovation subsidy funds/total assets of the company
	Host Country Innovation Environment	IE	Sum of the rankings of the host country's innovation index published in the Global Innovation Index report averaged
	Entrepreneurial Innovation Spirit	IS	logarithm of the number of domestic and foreign patent applications
	Market Competition	MC	$1 - \text{Herfindahl Index of the industry} = 1 - (\text{company's total operating income} / \text{industry's total operating income}) \times \text{Individual Herfindahl Index} = 1 - (\text{company's total operating income} / \text{industry's total operating income}) \times [(\text{total operating income} - \text{total operating costs} - \text{sales expenses} - \text{management expenses}) / \text{total operating income}]$
	Company Profits	CP	(Current year net profit – Previous year net profit)/Previous year's net profit

In the Qualitative Comparative Analysis research framework, the initial step involves calibrating the numerical values of variables to convert the raw data into fuzzy set membership scores ranging from 0 to 1. Three thresholds are determined, fully belonging, the crossover point, and not belonging at all, to capture the variability in the variables to different degrees. Based on the characteristics of each variable, this study employs the direct calibration method, first calculating calibration values annually, and then obtaining the overall calibration values [55]. Referring to the calibration criteria of Du Yunzhou et al. (2017), the 25th, 50th, and 75th percentile values of the continuous variables are used as anchor points for not belonging at all, the crossover point, and fully belonging, respectively [56]. This enables the robust and nuanced analysis of the factors influencing technological innovation behavior in Chinese multinational corporations [57]. Table 4 provides descriptive statistics and the calibration of variables for analyzing technological R&D innovation behavior. The variables include IB (R&D innovation behavior), GS (government support), IE (the host country's innovation environment), IS (entrepreneurial innovation spirit), MC (market competition), and CPs (company profits). An IB mean of 0.1916 indicates that companies allocate approximately 19.16% of the previous operating income to R&D, with moderate variation (S.D. = 0.0803). Total investment in R&D behavior yields a value of 0.286859, indicating lots of innovation. GS has an average support ratio of 0.1011, with minimal variation (S.D. = 0.0175), and full membership occurs at 0.114144, highlighting the influence of government support. IE shows considerable variation in innovation environments (mean = 14.8091, S.D. = 12.1635), with a full membership at 43, emphasizing the importance of innovative environments. IS displays a spread in innovation spirit (mean = 5.2443, S.D. = 2.0891), with full membership at 7.772154, indicating entrepreneurial solid innovation. MC has minimal variation (mean = 1.0002, S.D. = 0.0003), with full membership at 1.000642, suggesting intense competition drives innovation. CP averages at −0.0813 with large profit fluctuations (S.D. = 0.8327), and full membership in profit growth yields a value of 1.260526, which is essential for supporting innovation investments. From this, it can be found that although the innovation investment gap between the Chinese multinational companies is relatively small, there is a significant gap between entrepreneurial spirit and

company profits. These statistics provide insights into the factors influencing technological innovation within companies.

Table 4. Descriptive statistics and calibration of variables.

Variable Name	Obs	Mean	S.d.	Min	Max	Anchor Points		
						Full Membership	Crossover Point	No Membership at All
IB	1184	0.1916	0.0803	0	0.2890	0.286859	0.209318	0.001
GS	1184	0.1011	0.0175	0	0.1531	0.114144	0.103032	0.093645
IE	1184	14.8091	12.1635	2.5	43	43	9.583334	2.5
IS	1184	5.2443	2.0891	0	15.1955	7.772154	5.425055	0.001
MC	1184	1.0002	0.0003	0.99995	1.0006	1.000642	1.000048	0.999954
CP	1184	−0.0813	0.8327	−1.560	1.2605	1.260526	0.005042	−1.55999

3.2. Dynamic QCA Analysis Process

3.2.1. Univariate Necessary Condition Analysis

In the process of causal analysis utilizing the Qualitative Comparative Analysis (QCA) method, the crucial initial step involves scrutinizing individual variables to ascertain the necessary conditions for the outcome variables under investigation [58]. Consistency values serve as a pivotal metric in this assessment, providing a quantitative measure of the degree to which cases sharing a given condition or combination of conditions also share an outcome [59]. A consistency threshold exceeding 0.9, coupled with a consistency-adjusted distance below 0.2, is widely accepted as indicative that the condition variable in question can be considered a necessary condition for the outcome variable [52]. In cases where these predefined thresholds are not met, further exploration into the necessity of conditions becomes imperative to unravel the complex interplay of factors influencing the outcome variable.

Table 5 presents the necessary condition analysis for highly and not highly innovative behaviors in Chinese multinational corporations, calculated using R language software version 4.3.2. This study shows that no driving factors are essential for innovation behavior, though some factors have notable inter-group consistency-adjusted distances. For highly innovative behavior (IB), government support (GS) has moderate consistency (0.636) and coverage (0.724), but a low inter-consistency adjustment distance (0.092), indicating this is not a necessary solid condition. The host country's innovation environment (IE) has moderate overall consistency (0.559) and coverage (0.581), with a higher inter-consistency adjustment distance (0.214), suggesting it plays a more significant role. Entrepreneurial innovation spirit (IS) shows relatively high consistency (0.682) and coverage (0.787), indicating its importance in driving highly innovative behavior. For not highly innovative behavior (~IB), GS shows lower overall consistency (0.476) and coverage (0.442). IE has high overall consistency (0.718), indicating that fewer innovative environments correlate with not highly innovative behavior. A lack of entrepreneurial spirit (~IS) has significant inter-group consistency (0.262), highlighting its impact on not highly innovative behavior.

Table 6 presents the cases where the inter-group consistency-adjusted distance exceeds 0.2, revealing the absence of necessary conditions for highly innovative behavior among the Chinese multinational corporations. No consistency values exceed 0.9, indicating no universally essential conditions within the research sample. Significant inter-group consistency-adjusted distances suggest notable variation in how the different factors influence innovation behavior. Three main situations were identified: (1) IE/IB (the host country's innovation environment and highly innovative behavior) shows increasing consistency and coverage from 0.418 (2018) to 0.77 (2021), suggesting the host country's innovation environment's growing role; (2) ~IE/IB (Non-Innovative Environments and highly innovative behavior) with consistency ranging from 0.347 (2022) to 0.751 (2010), showing that innovation can occur even in less-innovative environments, likely due to in-

ternal factors; and (3) ~IS/IB (non-entrepreneurial innovation spirit and highly innovative behavior) with consistency from 0.353 (2021) to 0.736 (2007), indicating that some firms exhibit high innovation despite lacking entrepreneurial spirit, possibly due to compensating factors. These findings highlight temporal variability, diverse influences, and the complex interplay of factors affecting innovation, underscoring the need for a tailored approach to fostering innovation within different organizational contexts.

Table 5. Necessary condition analysis for individual conditions.

Condition Variables	Highly Innovative Behavior (IB)				Not Highly Innovative Behavior (~IB)			
	Overall Consistency	Overall Coverage	Inter-Consistency Adjustment Distance	Intra-Coder Consistency Adjusted Distance	Overall Consistency	Overall Coverage	Inter-Consistency Adjustment Distance	Intra-Coder Consistency Adjusted Distance
GS	0.636	0.724	0.092	0.395	0.476	0.442	0.153	0.553
~GS	0.51	0.544	0.131	0.509	0.703	0.612	0.114	0.404
IE	0.559	0.581	0.214	0.527	0.718	0.609	0.144	0.448
~IE	0.624	0.73	0.227	0.500	0.506	0.484	0.197	0.606
IS	0.682	0.787	0.184	0.404	0.434	0.409	0.184	0.606
~IS	0.487	0.513	0.262	0.579	0.774	0.665	0.044	0.386
MC	0.507	0.609	0.175	0.606	0.572	0.562	0.070	0.518
~MC	0.635	0.645	0.092	0.527	0.602	0.499	0.048	0.527
CP	0.569	0.641	0.171	0.334	0.57	0.525	0.144	0.351
~CP	0.578	0.622	0.188	0.281	0.61	0.536	0.162	0.219

Table 6. Cases where consistency adjustment distance between groups is greater than 0.2.

Situation	Situation 1		Situation 2		Situation 3	
Causal Combination Situation	IE/IB		~IE/IB		~IS/IB	
Index	Inter-Consistency	Inter-Coverage	Inter-Consistency	Inter-Coverage	Inter-Consistency	Inter-Coverage
2007	0.566	0.475	0.693	0.537	0.736	0.415
2008	0.551	0.488	0.717	0.607	0.706	0.453
2009	0.545	0.511	0.719	0.655	0.668	0.479
2010	0.517	0.497	0.751	0.678	0.624	0.478
2011	0.548	0.528	0.713	0.744	0.543	0.477
2012	0.579	0.57	0.656	0.767	0.525	0.505
2013	0.541	0.562	0.665	0.767	0.499	0.501
2014	0.482	0.565	0.677	0.736	0.475	0.517
2015	0.472	0.587	0.673	0.745	0.462	0.529
2016	0.467	0.59	0.67	0.748	0.391	0.519
2017	0.477	0.59	0.675	0.765	0.416	0.537
2018	0.418	0.606	0.731	0.755	0.398	0.558
2019	0.438	0.618	0.713	0.767	0.37	0.562
2020	0.747	0.673	0.375	0.856	0.363	0.591
2021	0.77	0.652	0.379	0.88	0.353	0.569
2022	0.768	0.667	0.347	0.877	0.507	0.65

3.2.2. Sufficiency Analysis of Conditional Configurations

The findings from necessary condition analysis underscore that any singular driving factor in isolation does not dictate the innovation behavior of Chinese multinational corporations. Consequently, the focus shifts toward identifying the combinations of conditions that collectively suffice to influence innovation behavior, a process known as the sufficiency analysis of conditional configurations. Sufficiency analysis hinges on leveraging consistency indicators to evaluate the adequacy of configurations [60]. To initiate sufficiency analysis, it is imperative to establish thresholds for raw consistency and frequency. This study determines the frequency threshold based on the sample size, set at 40. In

contrast, the Proportional Reduction in Inconsistency (PRI) threshold is established at 0.7, and the consistency threshold is fixed at 0.8 to construct a truth table. Consistent with established QCA methodologies, this study embraces a comprehensive reporting approach that includes intermediate solutions, complemented by an economical solution, to facilitate nuanced configuration analysis and offer a holistic understanding of the factors influencing innovation behavior within Chinese multinational corporations.

Table 7 presents the dynamic Qualitative Comparative Analysis (QCA) results, highlighting the configurations of antecedent conditions for highly and not highly innovative behaviors among Chinese multinational corporations. Analysis identifies four configurations (M1, M2, M3, and M4) for highly innovative behavior and two configurations (b1 and b2) for not highly innovative behavior. For innovation, government support (GS) and entrepreneurial innovation spirit (IS) are crucial, with high-level consistency (0.920 to 0.945) and PRI (0.844 to 0.903). In contrast, not highly innovative behavior shows the absence of GS and IS as critical factors, with lower consistency (0.844 and 0.853), and PRI (0.695 and 0.712). This underscores the significant role of internal and external support in driving innovation among these corporations.

Table 7. Configurations of antecedent conditions for R&D innovation behavior of Chinese multinational corporations.

Condition Variables	Highly Innovative Behavior				Not Highly Innovative Behavior	
	M1		M2	M3	M4	
	Config a1	Config a2	Config a3	Config a4	Config b1	Config b2
GS	●	·	●	●	⊗	
IE	⊗	·	·		●	●
IS	●	●	●	●	⊗	⊗
MC	⊗	·		⊗		·
CP			·	·	·	⊗
Consistency	0.920	0.925	0.933	0.945	0.844	0.853
PRI	0.859	0.844	0.863	0.903	0.695	0.712
Coverage	0.239	0.205	0.218	0.228	0.259	0.269
Unique Coverage	0.047	0.040	0.001	0.003	0.164	0.174
Inter-Coder Consistency Adjusted Distance	0.096	0.048	0.078	0.091	0.101	0.070
Intra-Coder Consistency Adjusted Distance	0.351	0.34	0.342	0.342	0.316	0.307
Overall PRI		0.837			0.704	
Overall Consistency		0.903			0.840	
Overall Coverage		0.392			0.433	

Note: ● indicates the core condition exists; ⊗ indicates the core condition is missing; · indicates the marginal condition exists; ⊕ indicates the marginal condition is missing; blank indicates the condition is irrelevant, regardless of whether it is present or missing.

3.2.3. Establishment of Dynamic Mechanism and Research Hypotheses

Based on the results of dynamic QCA, as depicted in Table 6, it is not only possible to verify the correctness of the driving factors, but also to analyze their impact paths through different pathways. This allows for the construction of the mechanism of the R&D innovation driving of Chinese multinational corporations. Analysis demonstrates the overall paths' high explanatory power with an overall consistency exceeding 0.8 for highly and not highly innovative behaviors and inter-case consistency-adjusted distances below 0.2 for the individual configuration paths. Several key insights can be drawn from sufficiency analysis: The innovation behavior of the Chinese multinational corporations in technology research and development (R&D) is a product of a synergistic interplay among multiple driving forces. Configurations M1-M3 reveal a powerful synergy between government support, entrepreneurial spirit, market competition, and innovation environment, which collectively

drive R&D innovation in companies. This synergy enhances companies' risk resilience and bolsters global competitiveness, laying the solid foundation for sustainable development.

Government support and entrepreneurial spirit emerge as the core drivers of R&D innovation in Chinese multinational corporations. Government support and entrepreneurial spirit are indispensable in all highly innovative behavior paths, mitigating the negative impact of the absence of an innovation environment and company profits [61]. In the not highly innovative behavior path models M4 and M5, as well as in M6, it was found that when either government support or entrepreneurial innovation spirit is absent, the Chinese multinational corporations engage in less R&D innovation. This further confirms the core driving role of government support and entrepreneurial spirit in R&D innovation. Government support provides direction and essential financial assistance for corporate R&D activities, encouraging Chinese MNCs to focus on strategic and forward-looking R&D projects [62]. This not only ensures the basic foundation for R&D, but also helps improve overall technological capabilities, while reducing the risk of R&D failure. Entrepreneurial spirit stimulates internal innovation, enabling MNCs to quickly seize market opportunities and promote R&D and innovation through well-planned strategies [63]. Additionally, entrepreneurial spirit is crucial for resource integration. Only with a strong entrepreneurial spirit can Chinese MNCs effectively mobilize both internal and external resources, supporting technological breakthroughs and successful R&D initiatives.

The host country's innovation environment is a crucial driving factor for the R&D efforts of Chinese multinational corporations. From the non-high R&D configurations b2 and b5, it can be observed that when other conditions are not sufficiently met, the absence of a favorable innovation environment significantly reduces the likelihood of companies engaging in R&D. This reveals that the innovation environment requires a foundation of other factors to effectively promote R&D activities in multinational corporations. The innovation environment provides essential knowledge, talent, and R&D infrastructure for corporate research efforts. Therefore, a poor innovation environment limits access to innovation resources, hindering companies from pursuing R&D and innovation activities. Moreover, the quality of the host country's innovation environment directly determines whether the company can effectively monitor market trends, influencing the accuracy of its judgment on the direction and timing of R&D innovation [52].

Market competition and company profits are the bedrock driving forces behind R&D innovation in companies. Configurations M1-M4 indicate that for companies to engage in R&D innovation, it is necessary to be driven by market competition or profit pursuit. However, more than these two driving forces are needed to bring about R&D innovation; they must cooperate with the other forces. Driven solely by profit, companies may prioritize projects that can directly generate profits in the short term, rather than undertaking the uncertainty and risks associated with innovation [64]. Moreover, if a company lacks entrepreneurial spirit, it may become conservative and unwilling to explore new ideas and technologies. Additionally, companies need more drive for profit pursuit and financial support for large-scale R&D activities, making it challenging to sustain innovation activities. Furthermore, in a fiercely competitive market environment, Chinese multinational corporations must continually seek innovation to maintain competitiveness [65]. Only by continuously optimizing products and services, improving efficiency, and seeking differentiated competitive advantages can Chinese multinational corporations iterate and upgrade, thus maintaining vitality.

Thus, the following hypotheses are proposed:

H1: *Entrepreneurial spirit has a positive impact on the R&D innovation behavior of Chinese multinational corporations, mediated by government support, market competition, and company profits.*

H2: *The host country's innovation environment plays a moderating role in the mediation effects of government support and market competition.*

Based on this, the mechanism of R&D innovation in Chinese multinational corporations is illustrated in Figure 2.

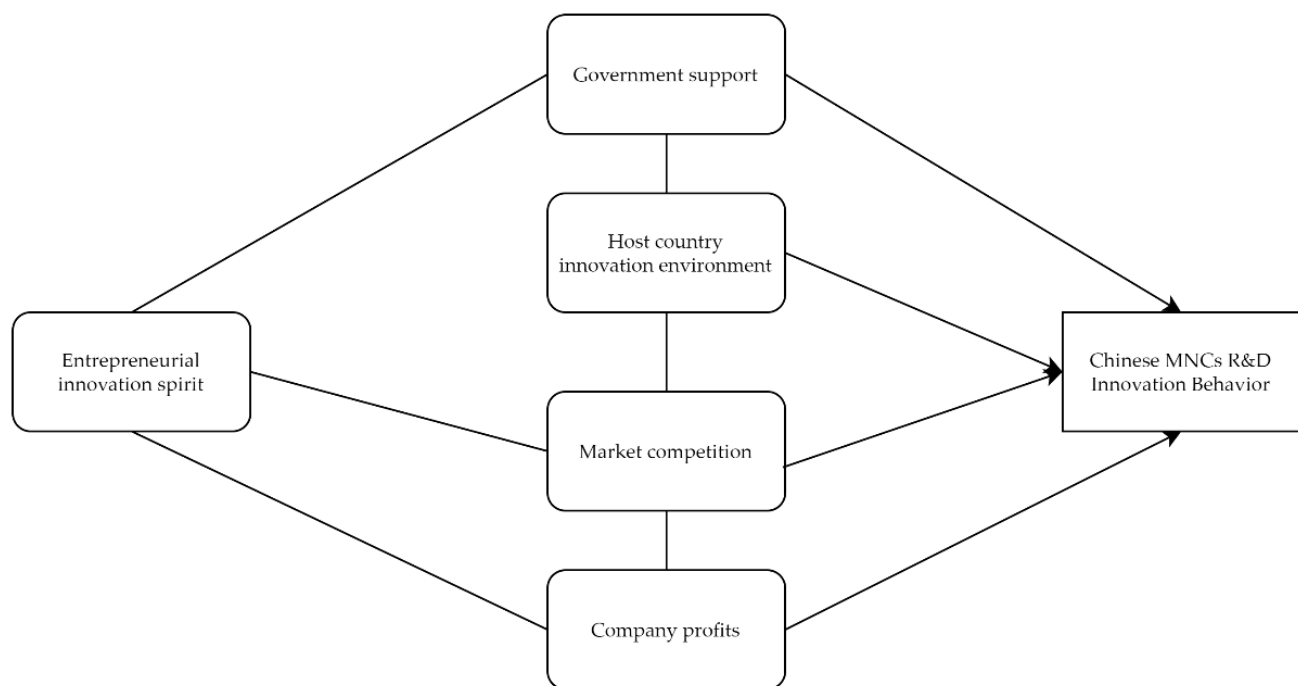


Figure 2. Mechanism of R&D innovation in Chinese multinational corporations.

4. Testing the Mechanism of Action of Chinese Multinational Corporations

Having established and validated the dynamic mechanism in the prior sections, qualitative analysis has shed light on the rationale behind technological R&D innovation within Chinese multinational corporations. However, the precise impact of these dynamic mechanisms on corporate innovation behavior, particularly the distinct roles played by the host country's innovation environment, market competition, and company profits in paths where government support and entrepreneurial innovation spirit are pivotal, still needs to be explored [66]. To explore these dynamics deeper, this study analyzes the specific effects of these mechanisms on innovation behavior. Analysis will investigate moderation and mediation effects by constructing a structural equation model (SEM) to unravel these factors' intricate interplay and influence on innovation behavior within Chinese multinational corporations [67]. By exploring these nuanced relationships, this study seeks to provide a comprehensive understanding of how these dynamic mechanisms shape and drive innovation behavior in the corporate landscape.

4.1. Research Design

This study establishes that government support and entrepreneurial innovation spirit are indispensable core drivers. At the same time, other driving forces are necessary to promote innovation behavior effectively. Based on this understanding, a mediation effect is evident, necessitating the construction of a model capable of handling multiple independent, dependent, and mediating variables [68]. The structural equation model (SEM) is the most appropriate. In addition, four control variables are added, namely (1) the Company Size (CS): the logarithm of total enterprise assets [69]; (2) Equity Concentration (EC): the square sum of the shareholding proportions of the top ten shareholders of a company [70]; (3) Redundant Resources (RRs): debt ratio = the ratio of total liabilities to total assets [71]; (4) and Company Age (CA): company age = natural logarithm of [1 + (observation year – company establishment date)].

Analyzing the dynamic mechanism of technological R&D innovation in Chinese multinational corporations reveals that government support, market competition, and company

profits mediate between entrepreneurial innovation spirit and R&D behavior. Moreover, the host country's innovation environment acts as a moderator, influencing the mediating effects of government support and market competition. This intricate interplay highlights the multifaceted nature of factors influencing innovation behavior within Chinese multinational corporations, underscoring the significance of both internal entrepreneurial drive and external environmental factors in shaping R&D initiatives and outcomes.

Therefore, the following two models are established:

1. Benchmark Model

$$TE_{it} = \alpha_0 + \alpha_1 MOTIVE_{it} + \alpha_2 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

IB_{it} stands for the technological innovation behavior of Chinese multinational corporations, $MOTIVE_{it}$ represents various driving mechanisms, and Controls denote the control variables.

2. Mediation Model

Based on the hypotheses, three types of mediating effects can be identified within the driving mechanism. The first is single mediation, where the mediating variables are government support, market competition, and corporate profit. The second is dual mediation, which includes two scenarios: dual mediation with government support and corporate profit, and dual mediation with government support and market competition. The third is moderated mediation, where the host country's innovation environment serves as a moderating variable, adjusting the mediating effect between government support and market competition. Therefore, three types of mediation model are established, single mediation, dual mediation, and moderated mediation, as shown in Equations (2)–(7). These models enable an exploration of the pathways through which the driving mechanisms impact the R&D innovation of Chinese multinational corporations.

(1) Single Mediation Effect Model

The models with only government support as a single mediator are represented by Equations (2) and (3), where CS_{it} represents entrepreneurial innovation spirit, and ME_{it} represents government support, market competition, or company profits.

$$ME_{it} = \beta_0 + \beta_1 CS_{it} + \beta_2 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (2)$$

$$TE_{it} = \gamma_0 + \gamma_1 CS_{it} + \gamma_2 ME_{it} + \gamma_3 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (3)$$

(2) Dual Parallel Mediation Effect Model

The dual parallel mediation effect model is represented by Equations (4)–(6), where GS_{it} represents government support, and MOE_{it} represents market competition or company profits.

$$GS_{it} = \beta_0 + \beta_1 CS_{it} + \beta_2 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (4)$$

$$MOE_{it} = \eta_0 + \eta_1 CS_{it} + \eta_2 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (5)$$

$$TE_{it} = \gamma_0 + \gamma_1 CS_{it} + \gamma_2 MOE_{it} + \gamma_3 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (6)$$

(3) Moderated Mediation Effect Model

Using the host country's innovation environment as the moderating variable, Equation (6) is adjusted to obtain the moderated mediation effect model, as shown in Equation (7), where IE_{it} refers to the host country's innovation environment, and ME_{it} refers to government support and market competition.

$$TE_{it} = \varphi_0 + \varphi_1 CS_{it} + \varphi_2 ME_{it} + \varphi_3 IE_{it} + \varphi_4 ME_{it} * IE_{it} + \varphi_5 Controls_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (7)$$

4.2. Mediation Analysis

4.2.1. Baseline Regression

Table 8 presents the outcomes of the least squares regression for the variables impacting technological innovation research and development (R&D) among the Chinese multinational corporations. The coefficients reveal the magnitude and direction of influence of each independent variable on R&D innovation. Government support exhibits coefficients ranging from 0.5675 to 0.7169 across paths, which are all statistically significant at the 0.001 level, indicating its significant positive impact on R&D innovation. Similarly, entrepreneurial innovation spirit, with coefficients ranging from 0.1538 to 0.3920, showcases a strong positive association with R&D innovation. While the host country's innovation environment lacks significance in the third path, the coefficients in the other paths range from -0.0138 to -0.0146 because a lower value is better, so this also indicates varying impacts. Market competition consistently demonstrates positive and significant coefficients (from 0.2900 to 0.3520), affirming its role in fostering R&D innovation. Conversely, company profits exhibit consistently negative and significant coefficients (from -0.0575 to -0.0635), suggesting that higher profitability is linked with reduced investment in innovative projects, possibly due to risk aversion.

Table 8. Results of baseline regression.

Var	(1)		(2)		(3)		(4)	
GS	0.7131 *** (10.7265)	0.5675 *** (8.6674)	0.7163 *** (10.8472)	0.5910 *** (9.0985)	0.7109 *** (10.7371)	0.5683 *** (8.7155)	0.7169 *** (10.8071)	0.5733 *** (8.7728)
IS	0.1538 *** (6.8664)	0.3891 *** (15.1580)	0.1549 *** (6.9568)	0.3782 *** (14.8547)	0.1563 *** (6.9980)	0.3858 *** (15.0826)	0.1601 *** (7.1564)	0.3920 *** (15.3000)
IE			-0.0139 *** (-5.7554)	-0.0146 *** (-6.1755)	-0.0138 *** (-5.6967)	-0.0144 *** (-6.0601)		
MC			0.2900 *** (8.8112)	0.3520 *** (10.1903)				
CP					-0.0627 *** (-6.0280)	-0.0575 *** (-5.6608)	-0.0635 *** (-6.0857)	-0.0582 *** (-5.7149)
CS		-0.5645 *** (-14.7445)		-0.5127 *** (-13.4176)		-0.5486 *** (-14.3724)		-0.5566 *** (-14.5586)
EC		-0.0221 *** (-5.2410)		-0.0232 *** (-5.5372)		-0.0224 *** (-5.3259)		-0.0218 *** (-5.1833)
RR		-0.3465 *** (-4.9829)		-0.6178 *** (-8.3627)		-0.3608 *** (-5.2073)		-0.3608 *** (-5.1960)
CA		-1.0432 *** (-6.7657)		-1.1269 *** (-7.3552)		-1.1124 *** (-7.2276)		-1.0463 *** (-6.7995)
Industry				Control				
year				Control				
cons	2.7875 *** (31.2501)	18.4195 *** (20.4107)	2.7050 *** (25.1893)	17.5185 *** (19.3911)	3.0015 *** (29.8773)	18.5132 *** (20.5571)	2.7381 *** (30.6400)	18.2159 *** (20.2105)
R ²	0.2735	0.3094	0.2836	0.3216	0.2798	0.3153	0.2769	0.3122

Note: *** represents the 1% significance level. The t-values are shown in parentheses.

4.2.2. Single and Dual Parallel Mediation Effect Tests

(1) Single Mediation Effect Test

Building upon the baseline regression analysis, models (2) and (3) were rigorously tested. The findings reveal that entrepreneurial innovation spirit significantly and positively fosters technological innovation within Chinese multinational corporations through government support and market competition. At the same time, company profits exhibit a negative impact. Several factors contribute to these outcomes: Firstly, government support is pivotal in incentivizing and guiding entrepreneurial innovation. Government policies offering financial support, tax incentives, and technical assistance encourage enterprises to bolster technological research and development investments [72]. Entrepreneurs will likely respond positively to such support, recognizing its potential to catalyze innovation

activities. Government initiatives often prioritize entrepreneurs and enterprises demonstrating innovative vision, fostering a conducive environment for innovation [73]. Moreover, government policies tend to align with market demands and industrial progress in technological R&D. The synergy between entrepreneurial innovation spirit and government policies geared towards market orientation enables enterprises to align innovation investments with market needs, enhancing the precision and efficacy of R&D efforts [74]. This collaborative approach between government support and entrepreneurial drive equips enterprises with the necessary resources and motivation to drive technological research and development innovation, ultimately leading to significant advancements in the innovation landscape [75].

Secondly, market competition is crucial in stimulating innovation consciousness within Chinese multinational corporations. The intense competitive landscape compels these corporations to continuously seek new market opportunities and competitive advantages, thereby focusing on enhancing product or service quality and differentiation through innovation and reducing costs [76]. This relentless pursuit of innovation is driven by the need to stay ahead of competitors and maintain a competitive edge. Furthermore, the fierce market competition prompts Chinese multinational corporations to remain highly sensitive and responsive to market dynamics. Through continuous market research and analysis, they can predict and grasp the industry trends, changes in consumer behavior, and potential market opportunities, thereby promoting market-oriented technological research and development innovation within the company [77]. This market-driven approach to innovation enables corporations to develop products and services tailored to meet consumers' evolving needs, fostering a culture of innovation and entrepreneurship [78].

Lastly, company profits play a significant role in shaping the entrepreneurial mindset towards risk aversion. When companies experience profitability, there is a tendency to prioritize resources towards areas with stable returns, such as enhancing production efficiency, expanding the market share, or focusing on traditional business activities like marketing. This focus on maintaining profit stability often leads to a reluctance to invest in innovative research and development, as the risks associated with innovation may be perceived as jeopardizing the current profitability levels. This risk-averse approach can stifle the expression of entrepreneurial spirit within the organization and dampen the willingness to pursue innovation initiatives. Additionally, publicly listed multinational corporations face pressure from shareholders and the market to deliver a strong short-term financial performance, which can further reinforce a short-term profit-oriented mindset among management [79]. This emphasis on immediate financial results may divert attention from long-term research and development investments and innovative endeavors, potentially hindering the company's ability to drive sustained innovation and adapt to changing market dynamics effectively.

Table 9 illustrates single mediation effect analysis, revealing how government support, market competition, and company profits mediate the relationship between entrepreneurial innovation spirit (IS) and technological innovation (TE) in Chinese multinational corporations. The direct effect of IS on TE is significant, ranging from 0.0442 to 0.4593, highlighting its positive influence on technological innovation. Moreover, the mediating effects of government support and market competition are substantial, ranging from 0.3614 to 0.3156, showcasing the partial mediation between IS and TE. However, the mediating effect of company profits appears significant and negative, ranging from -0.3518 to -0.3518 , indicating that company profits act as a partial suppressor, diminishing the IS-TE relationship. The total effect of IS on TE remains significant, encompassing both direct and indirect impacts, further emphasizing their intricate interplay in shaping technological innovation outcomes in Chinese multinational corporations.

Table 9. Results of single mediation effect.

Var	(1) Mediating Variable: Government Support		(2) Mediating Variable: Market Competition		(3) Mediating Variable: Company Profits	
	GS	IB	MC	IB	CP	IB
IS	0.0442 *** (11.72)	0.4593 *** (35.82)	0.0172 *** (20.6665)	0.4105 *** (31.4018)	0.0202 *** (4.5162)	0.4231 *** (33.4319)
Mediating variable		0.3614 *** (9.45)		0.3156 * (1.8373)		−0.3518 *** (−11.0552)
Cons	2.4712 *** (20.49)	13.9057 *** (33.32)	1.8139 *** (91.3325)	8.1804 *** (18.8188)	−0.6706 *** (−6.3013)	8.5170 *** (28.2425)
Control variable			Control			
industry			Control			
year			Control			
Bootstrap Results of Mediation Effect						
Mediation effect	Coefficient	95% confidence interval	Coefficient	95% confidence interval	Coefficient	95% confidence interval
Total effect	0.297 *** (19.96)	0.2681, 0.3265	0.2949 *** (19.74)	0.2656, 0.3242	0.2949 *** (19.74)	0.2656, 0.3242
Direct effect	0.286 *** (18.99)	0.2567, 0.3158	0.2842 *** (19.25)	0.2553, 0.3132	0.3057 *** (20.26)	0.2761, 0.3352
Indirect effect	0.0111 *** (3.04)	0.0040, 0.0182	0.0107 *** (3.98)	0.0054, 0.0160	−0.0107 *** (−5.93)	−0.0143, −0.0072

Note: * represents the 10% significance level, *** represents the 1% significance level. The t-values are shown in parentheses.

(2) Dual Parallel Mediation Effects Test

Table 10 presents results from structural equation modeling (SEM) testing on Equations (4)–(6), elucidating the intricate dynamics between government support, market competition, company profits, and their mediating effects on the relationship between entrepreneurial innovation spirit and technological innovation in Chinese multinational corporations. Table 10 illustrates the results of dual parallel mediation effects analysis, focusing on how government support interacts with market competition and company profits to influence the relationship between entrepreneurial innovation spirit (IS) and technological innovation (TE) in Chinese multinational corporations. The coefficient for the direct effect of IS on TE is significant (0.0425 ***), indicating a positive association between IS and TE. The coefficient for the mediating effect of government support on the relationship between IS and TE is also significant (0.3556 ***), suggesting that government support partially mediates this relationship. However, the presence of market competition exhibits a significant negative coefficient (0.017 ***), implying that it weakens the positive influence of IS on TE, and government support might substitute for its effect. The other mediating variables are government support and company profits. Similar to previous analysis, the direct impact of IS on TE remains significant (0.0425 ***). The mediating effect of government support is essential (0.3547 ***), indicating partial mediation. In contrast, the coefficient for company profits is significantly negative (−1.0316 **), implying its inhibiting effect on the IS-TE relationship, and government support partially substitutes for its impact. These findings suggest that while government support consistently promotes technological innovation, market competition's impact may be weakened or substituted by government support. This implies that upon receiving government support, Chinese multinational corporations may become less responsive to market competition, potentially leading to decreased investment in innovation due to reliance on government resources for stability and preferential conditions.

Table 10. Results of dual parallel mediation effect.

Var	(1) Mediating Variable: Government Support and Market Competition			(2) Mediating Variable: Government Support and Company Profits		
	GS	MC	IB	GS	CP	IB
IS	0.0425 *** (6.54)	0.017 *** (3.62)	0.4328 *** (8.87)	0.0425 *** (6.54)	0.0229 *** (3.81)	0.4221 *** (8.69)
GS			0.3556 *** (4.00)			0.3547 *** (4.03)
Another Mediating variable			−1.0316 ** (−2.26)			−0.2604 *** (−6.37)
Cons	1.6188 *** (4.71)	0.8487 ** (3.38)	14.3775 *** (13.92)	1.6189 *** (4.71)	−0.4005 * (−1.69)	13.3275 *** (12.82)
Control Variable			Control			
Industry			Control			
Year			Control			
Bootstrap Results of Mediation Effect						
Mediation effect	Coefficient	95% confidence interval		Coefficient	95% confidence interval	
GS	0.0151 *** (6.56)	0.0106, 0.0196		0.0151 *** (6.73)	0.0107, 0.0195	
Another Mediating variable	−0.0175 *** (−3.69)	−0.0268, −0.0082		−0.0060 *** (−4.8)	−0.0084, −0.0035	
Direct effect	0.4303 *** (14.48)	0.3742, 0.4914		0.4221 *** (14.78)	0.3662, 0.4781	
Subtracting Two Mediation effects	0.0326 *** (4.81)	0.0193, 0.0459		0.0210 *** (11.46)	0.0174, 0.0246	
Indirect effect	0.4328 *** (14.99)	0.3741, 0.4866		0.4312 *** (14.74)	0.3739, 0.4886	

Note: * represents the 10% significance level, ** represents the 5% significance level, *** represents the 1% significance level. The t-values are shown in parentheses.

4.2.3. Moderated Mediation Analysis

Employing structural equation modeling (SEM), the empirical findings unveil government support and market competition as the mediating variables, while incorporating the host country's innovation environment as the moderating variable. Table 11 elucidates the impact of the host country's innovation environment as the moderating factor on the mediation effects of government support (GS) and market competition (MC) between entrepreneurial innovation spirit (IS) and technological innovation (TE) by Chinese multinational corporations. Notably, the effects of mediation become more pronounced as the innovation environment improves from bad to good. For GS, the coefficients for poorly, moderately, and highly innovative environments are 0.0111 ** (3.03), 0.0115 ** (2.79), and 0.0119 ** (2.36), respectively, indicating a significantly positive relationship. Similarly, for MC, the coefficients for poorly, moderately, and highly innovative environments are 0.0102 *** (4.00), 0.0115 *** (4.05), and 0.0127 *** (3.97), respectively, reflecting a significant positive association. These results underscore the pivotal role of a conducive innovation environment in amplifying the mediating effects of government support and market competition, fostering more effective technological innovation endeavors by Chinese multinational corporations. Moreover, such environments promote collaboration among enterprises, research institutions, and investors, with market competition as the catalyst for innovation. In highly innovative settings, markets are more receptive to new technologies, enabling entrepreneurs to leverage competition for rapid iteration and optimization, ultimately expediting the commercialization of innovative outcomes.

Table 11. Results of mediation effects and moderating effects.

Mediating Variable	Host Country Innovation Environment Moderation Effect	Coefficient	Standard Error	95% Confidence Interval
GS	low	0.0111 ** (3.03)	0.0037	0.0039, 0.0182
	Midi	0.0115 ** (2.79)	0.0041	0.0034, 0.0196
	high	0.0119 ** (2.36)	0.0050	0.0020, 0.0218
MC	low	0.0102 *** (4.00)	0.0026	0.0052, 0.0153
	Midi	0.0115 *** (4.05)	0.0028	0.0059, 0.0170
	high	0.0127 *** (3.97)	0.0032	0.0064, 0.0190

Note: ** represents the 5% significance level, *** represents the 1% significance level. The t-values are shown in parentheses.

5. Conclusions

By using the qualitative analysis method grounded in a theory, the five main driving forces influencing technological innovation in Chinese multinational corporations (MNCs) were identified: government support, the host country's innovation environment, entrepreneurial spirit, market competition, and company profits. Based on this, a dynamic mechanism model was established, incorporating these five driving forces into a unified analytical framework to explore how they interact and influence each other, collectively driving the technological R&D innovation of Chinese MNCs.

Subsequently, the correctness of this mechanism was validated using dynamic Qualitative Comparative Analysis (QCA). Initially, from the perspective of the total sample, it was found that the technological R&D innovation behavior of Chinese MNCs is the result of the combined action of multiple driving forces. Government support and market competition intensity were identified as the core driving forces of R&D innovation in Chinese MNCs, while the innovation environment was highlighted as an important driving force. Entrepreneurial spirit and company profits were recognized as the foundational driving forces for technological R&D innovation. Finally, by constructing a structural equation model (SEM) to analyze the existence of moderation and mediation effects, it was discovered that government support acts as a mediator between entrepreneurial spirit and technological R&D innovation behavior in Chinese MNCs. Moreover, this mediation effect is positively moderated by the host's country innovation environment, market competition, and company profits.

In conclusion, the technological R&D innovation of Chinese MNCs is a complex and dynamic process influenced by multiple factors. Government support, the host's country innovation environment, entrepreneurial spirit, market competition intensity, and company profits play different roles in Chinese MNCs of varying natures and investment locations.

Although this study has conducted the relatively comprehensive analysis of the driving forces behind the technological R&D innovation behavior of Chinese multinational corporations, it is limited by the dynamic QCA method, which requires balanced panel data. Considering data availability, the research sample only includes A-share listed companies engaged in multinational operations prior to 2007, thus not covering all Chinese multinational corporations. In future research, as the methodological approaches improve and China's multinational development strategy further evolves, it will be possible to study a broader range of samples. Additionally, taking the perspective of the corporate life cycle theory, the future studies could conduct comparative analyses of companies at different stages of international expansion, thereby enriching the theoretical framework of innovation drivers.

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