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Incremental versus Radical Innovation and Sustainable Competitive Advantage: A Moderated Mediation Model

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Abstract: Innovation is critical for organizations seeking to build and maintain a sustainable advantage in the competitive market. This study aims to construct a moderated mediation model to examine the effects of incremental and radical innovations on competitive advantage, which considers the mediating role of innovation speed and the moderating role of a supportive culture. Data from 201 Chinese firms were collected through questionnaires and the research hypotheses were tested using multiple regression analysis and bootstrapping techniques. The empirical results show that incremental and radical innovations have a significant positive effect on competitive advantage. Radical innovation has a greater impact on competitive advantage compared to incremental innovation. Innovation speed mediates the relationship between incremental and radical innovations and competitive advantage. Supportive culture positively moderates the relationship between incremental and radical innovations and innovation speed. Moreover, supportive culture positively moderates the conditional indirect effect of incremental and radical innovation on competitive advantage through innovation speed. Theoretical and practical implications are further discussed.

Keywords: radical innovation; incremental innovation; supportive culture; innovation speed; competitive advantage

1. Introduction

Innovation is an important cornerstone of China's digital economic transformation and is the primary driver of national economic growth. With an increasingly fierce global competitive environment, innovation is vital for enterprises to improve their competitiveness and maintain sustainable competitive advantages [1–3]. Previous studies have reported mixed evidence on the relationship between innovation and competitive advantage. Some studies have shown that innovation has a positive impact on competitive advantage [3–8], while other studies have found that innovation has a low or negative impact on competitive advantage [9]. One possible reason for this mixed result might be the differences in the type of innovation. As research by Lee et al. [10] suggested, only focusing on a single type of innovation may hinder the potential advantages that come from diversifying innovations.

Incremental and radical innovations, which are categorized according to the degree of novelty of the innovation [11–14], have attracted the attention of academics and practitioners [15,16]. Radical innovations reflect a high degree of novelty, yet incremental innovations exhibit a lower degree of novelty [17–19]. Incremental innovation involves slight improvements to existing technologies, products, and services that can increase a company's market share, improve competitiveness, and strengthen its market position [20–22]. Radical innovation involves developing new technologies, products, or services and making existing ones obsolete, completely changing the competitive landscape and creating new business prospects [19,23,24]. It is generally recognized that incremental and radical innovations are crucial for the long-term survival and growth of a firm.

Although the current literature implicitly assumes that incremental innovation and radical innovation are necessary to improve a firm's competitive advantage [16,22,25,26], research on how incremental innovation and radical innovation impact a firm's competitive advantage remains limited. Previous studies have explored the impact of different types of innovations on firms' competitive advantage, such as market innovation [8], product and process innovations [27], open innovation [28], ambidextrous innovation [29], and collaborative dual innovation [6]. However, there is still a lack of rigorous empirical support for the impact of incremental and radical innovations on competitive advantage. Also, there is still no empirical evidence to suggest which type of innovation has a greater impact on competitive advantage.

Additionally, prior studies suggested that innovation speed is closely related to radical and incremental innovation [30–32]. Moreover, most studies have shown that accelerating innovation speed improves innovation efficiency, reduces research and development costs, sets industry standards, enhances product competitiveness, and increases market share and margins [33,34]. Innovation speed is necessary for businesses to gain a competitive advantage [35,36]. Previous research has indicated that innovation speed plays a key mediating role between innovation and competitive advantage [37,38]. However, there are fewer empirical studies on the mediating role of innovation speed in radical and incremental innovation affecting competitive advantage relationships.

Furthermore, cultural context could have an impact on the relationship between innovation and firm performance [2,39]. Several studies have suggested that organizational culture plays an important role in organizational innovation [40,41], such as competing value framework [40,41] and organizational learning culture [42]. Supportive culture has been regarded as one of the organizational cultures conducive to innovation [43,44], which represents mutual learning and knowledge sharing, friendly communication and collaboration, trust, and an encouraging work environment. Supportive culture can motivate employees to work more efficiently and effectively in the organization [45–47]. In addition, some studies have shown that organizational culture influences incremental and radical innovation [48,49]. However, there is still no empirical support for supportive culture as a boundary condition for the relationship between incremental and radical innovation and competitive advantage.

Given the above, this study developed a moderated mediation model to close these research gaps. First, we examine the impact of incremental and radical innovations on competitive advantage to understand which types of innovation contribute more to a firm's competitive advantage. Second, we explore the mediating role of innovation speed to understand the paths through which the two types of innovations affect firms' competitive advantage. Third, we analyze the moderating role of a supportive culture to reveal how a supportive work environment enhances the impact of different types of innovations on competitive advantage. By examining this relationship and thus providing valuable insight into their interactions. Our findings provide useful references for corporate innovation practice and enrich the theoretical knowledge system of innovation management.

The remainder of this study is organized as follows: Section 2 introduces a literature review, hypotheses, and research model. Section 3 describes the materials and methods. Section 4 reports the empirical results. Section 5 presents research conclusions and discussions.

2. Theory and Hypotheses

2.1. The Relationship between Incremental and Radical Innovation and Competitive Advantage

Incremental innovation, which still dominates most industries, relies on a firm's existing structures and processes and involves small but significant improvements to products and processes [50]. Herbig et al. [51] described three types of incremental innovation—continuous, modified, and process innovations. Incremental innovation refers to refining the existing technological trajectory and making minor improvements to enhance the existing technology [12]. Although incremental innovations involve relatively small technological changes in each unit, their cumulative effect often exceeds that of the original innovation [52,53]. Incremental inno-

vation increases a firm's competitive advantage by making its product more novel, valuable, and reliable, while better meeting the market demands and promoting consumer loyalty and brand credibility [19,25].

In addition, incremental innovation does not require costly and complicated technology, which effectively reduces the risk of business innovation and enables firms to provide products and services at more competitive prices to gain a competitive advantage [54]. Previous studies have shown that incremental innovation leverages and develops the firms' prior technological capabilities, which positively affects new product development performance [55], business performance [56], and financial performance [57]. On the one hand, as argued by Banbury and Mitchell [20], the higher the number of industry incumbents to first introduce major incremental product innovations, the greater the market share and the more advantageous it is. Huvaj and Johnson [58] found that complex firms are more inclined to pursue incremental innovation, given their monitorable R&D investment as well as predictable benefits. On the other hand, to enhance their competitive advantage in an intensely competitive environment, SMEs may engage in incremental innovation activities such as launching new differentiated products, extending their product lines, developing new market segments, and creating new distribution formats [21,22]. In summary, incremental innovation helps established firms deal with competitive pressures [53] and creates a competitive opportunity window for SMEs [59].

Radical innovations are higher-order innovations compared to incremental innovations and involve a fundamental change to a technology or product [60]. Radical innovations are adoptable innovations and must be novel, unique, and have a significant impact on future technologies [61]. Previous research has shown that large companies choose to introduce radical product innovations due to economies of scale and scope, even though they require costly resources and a tolerance for failure [12,62]. Radical innovations can have a significant impact not only on a firm's market share, but also on its financial performance [57], which can enhance or reshape a firm's competitive advantage [63].

Radical innovation has a long-term and significant impact on a company's competitive advantage. First, radical innovation is a key engine of growth for firms [64], which helps firms develop unique products, establish industry standards or dominant designs, and provide a first-mover advantage, which allows firms to dominate in a competitive marketplace [31,65]. Second, radical innovation allows firms to avoid the capability trap of incremental innovation and is essential for firms to remain competitive in the long term [66]. Slater and Mohr et al. [67] identified radical product innovation capability as a dynamic capability that delivers superior organizational performance by creating new businesses that enable new product development and commercialization, providing unprecedented customer benefits [68]. Third, radical innovation establishes a new industry by enabling the development of new technologies and products that meet potentially unique customer and market needs [69], creating new market opportunities and reshaping the existing competitive landscape [23,24]. In conclusion, despite the high-risk nature of radical innovation, radical innovation leads to disruptive change that can help firms achieve a temporary profit monopoly and a sustainable competitive advantage in the marketplace [16,26].

Based on the above considerations, we hypothesize the following:

H1a. *Incremental innovation has a positive impact on competitive advantage.*

H1b. *Radical innovation has a positive impact on competitive advantage.*

2.2. The Mediating Role of Innovation Speed

In a highly competitive business environment, a company must continue to innovate rapidly to meet fast-changing customer needs. In this context, the speed of innovation has been a major focus for companies and scholars. Previous studies use different terminology to describe the speed of innovation, including innovation speed [70], speed-to-market [71], new product development speed [34], etc. Collectively, these studies show that innovation

speed represents the time from the initial product concept to the ultimate commercialization of a new product.

Innovation speed plays an important role in creating and sustaining competitive advantage. First, innovation speed has a positive impact on new product success [35]. Several studies have shown that faster innovation speed reduces costs and delivers higher product quality with superior customer benefits to maximize product advantage [36,71]. Second, innovation speed favors the profitability and brand image of the company [34]. By shortening the product development cycle and bringing new products to market faster, to meet consumer demand, the company can enhance its reputation in the consumer market and improve its brand image. Third, innovation speed results in superior performance [72]. Companies that are the first to bring new products to the market can be very profitable [30,71]. In short, innovation speed is positively associated with firms' competitive advantage.

We further argue that innovation speed mediates the effects of incremental and radical innovation on competitive advantage. On the one hand, incremental innovation is positively related to innovation speed. First, incremental innovation uses existing technology, knowledge, and experience to make small improvements and optimizations to known new product development projects based on previously collected customer feedback [71], thus increasing innovation speed. Specifically, companies can iterate innovative products in a short period through testing and improvement [32]. Second, incremental innovation is about the accumulation of knowledge and experience [73]. Companies can accelerate innovation by incorporating the knowledge and experience of incremental innovation into later innovation processes.

On the other hand, radical innovation is positively related to innovation speed. First, radical innovation creates a first-mover advantage by creating entirely new technologies or products and establishing the industry's dominant design and technology standards [31]. Introducing new and innovative products to the market can be highly profitable before competitors [30]. Second, radical innovation products achieve the first commercialization to drive innovation speed in new industries [12]. Lee [74] indicated that the greater the degree of radicalization of innovation, the greater the degree of diffusion within the industry and the faster the innovation speed.

We thus hypothesize the following:

H2a. *Innovation speed mediates the relationship between incremental innovation and competitive advantage.*

H2b. *Innovation speed mediates the relationship between radical innovation and competitive advantage.*

2.3. The Moderating Role of Supportive Culture

Definitions of organizational culture vary, but it is widely recognized that organizational culture is the specific values and beliefs rooted within an organization that provide norms of behavior and guide the activities and actions of the organization [75]. Based on the resource-based view, as an important intangible resource, organizational culture can bring sustainable competitive advantage to an enterprise [76]. As an essential organizational culture, a supportive culture represents a trusting, encouraging, open, collaborative, and relationship-oriented work environment that benefits a company's long-term innovative performance in a dynamic environment [77]. Supportive cultures promote the acceptance of innovative concepts by employees and the initiation of innovations, as well as the fact that employees are better equipped to support one another and collaborate with others [44]. Accordingly, this study suggests that supportive cultures may moderate the effects of incremental and radical innovation on innovation speed, as demonstrated by the following points:

First, incremental innovation improves existing products by enhancing existing knowledge [64]. A supportive culture encourages employees to communicate and collaborate,

promoting the sharing of knowledge and experience [45], which strongly supports incremental innovation and accelerates its pace. Furthermore, radical innovation emphasizes the reforming of mainstream knowledge to eliminate obsolete knowledge and generate new knowledge to innovate [73]. Employee tacit knowledge sharing, transformation, and application enable companies to achieve radical innovation breakthroughs [78], significantly accelerating the pace of innovation.

Second, supportive culture reflects a trusting, safe, and collaborative working environment that increases employee commitment and job satisfaction [79,80], encourages collaborative problem-solving among employees, and facilitates quality improvement practices in the organization [81]. An organizational environment in which firms provide encouragement and rewards can increase employees' psychological safety to promote incremental and radical innovation [82,83].

Third, supportive culture is a decentralized organizational structure that encourages employees to participate in decision-making and management, to stimulate their potential, and to satisfy their need for self-actualization [84]. Dewar and Dutton [14] showed that decentralization facilitates firms to engage in incremental innovations, while Huvaj and Johnson [58] indicated that firms with a complex organizational structure will produce fewer radical innovations, but will produce more incremental innovations. In this context, incremental and radical innovations are implemented more efficiently and rapidly. Having considered the above, we propose the following hypotheses:

H3a. *Supportive culture positively moderates the relationship between incremental innovation and innovation speed.*

H3b. *Supportive culture positively moderates the relationship between radical innovation and innovation speed.*

Furthermore, as previously stated, both incremental and radical innovation can improve competitive advantage by increasing innovation speed. In addition, a supportive culture can positively moderate the relationship between incremental and radical innovation and innovation speed. Thus, given the above prediction that supportive culture plays a moderating role in the theoretical model of incremental and radical innovation–innovation speed–competitive advantage, supportive culture will moderate the indirect effect of innovative capability on competitive advantage through innovation speed. Accordingly, we hypothesize the following:

H4a. *Supportive culture positively moderates the mediating role of innovation speed between incremental innovation and competitive advantage.*

H4b. *Supportive culture positively moderates the mediating role of innovation speed between radical innovation and competitive advantage.*

The research model of this paper is shown in Figure 1.
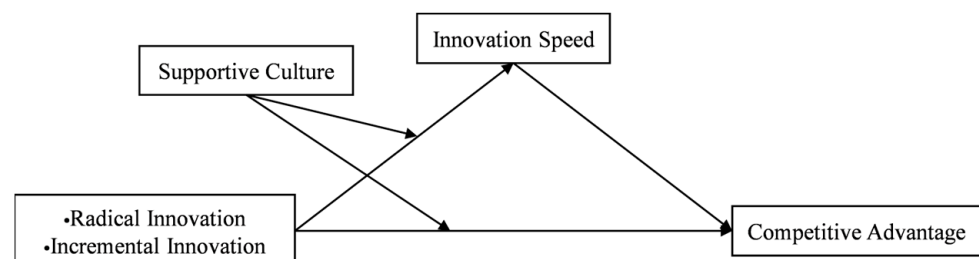
Figure 1. Research model.

3. Methodology

3.1. Data Collection

This study identified questionnaire items based on previous research; the original questionnaire was developed using translation and back-translation methods. To ensure readability, comprehensibility, and reliability, the questionnaire was revised and improved by integrating the suggestions of academic experts in the field of innovation management and the pre-survey feedback from 10 business managers.

Given the generalizability of the study and to ensure the return rate of the questionnaire, the respondents of this study are set to be business managers in various industries in the Yangtze River Delta region of China, which has a high level of innovation activity. This study distributed 300 questionnaires to collect data by sending online questionnaires to "acquaintances", university MBA students, and enterprise managers of science and technology parks; the respondents were middle-level or senior-level managers. All questionnaires are anonymous and adopt the avoidance principle. After discarding invalid samples such as missing data and other irregular unanswered questions from the 230 questionnaires received, 201 valid samples were retained, giving a sample recovery rate of 67%. Firms in the sample are mainly located in the more innovative regions of China (90.55%), such as Beijing, Shanghai, Hangzhou, and so on. In total, 73.13% of the firms are small and medium-sized enterprises (SMEs), which are mainly concentrated in traditional manufacturing (28.36%) and high-tech industries (42.29%). Overall, the sample comparison met the requirements of this study.

3.2. Measures

We searched the Web of Science database using incremental innovation, radical innovation, and competitive advantage as topic keywords and focused mainly on peer-reviewed journal articles; we excluded articles that did not fit the research theme, obtaining 395 articles. We relied on recent reviews [2,85] as well as our literature review to identify relevant variables for this study.

All measurement scales were used from previous studies and were then modified to ensure content validity and facilitate data collection and analysis. We employed a seven-point Likert-type scale (from strongly disagree to strongly agree) to assess the innovation capability and supportive culture variables. Next, we used a five-point Likert-type scale (from strongly disagree to strongly agree) to measure the variables of innovation speed and competitive advantage.

The dependent variable is competitive advantage. To investigate the new product innovation performance of the company, we adapted items from a study by Carbonell et al. [86]. The sample items include five questions, as follows: a new product or service gives us an important competitive advantage; product/service experience was superior to competitors; customer solution was superior to competitors; increased brand awareness; and satisfaction with new products.

The independent variable is incremental innovation and radical innovation. Items were proposed by Subramaniam and Youndt [73]. The measure of incremental innovation has three questions, as follows: innovations that reinforce your prevailing product/service lines; reinforce your existing expertise in prevailing products/services; and reinforce how you currently compete. Radical innovation was measured using three questions including the following: innovations that make your prevailing product/service lines obsolete; make your existing product/service lines obsolete; and fundamentally change your prevailing products/services.

The mediator is innovation speed. Items proposed by Carbonell et al. [86] were used to investigate the new product speed of commercialization. The sample items include three questions, as follows: developed and launched faster than major competitors; completed in less time than what was considered normal for the industry; and launched ahead of the original schedule that was developed.

The moderator is supportive culture. Items were proposed by Wallach [77] and formed a supportive culture [43]. These indicators contain two aspects—relationship and environment. The items include the following: relationship-oriented; employees trust each other; employees are collaborative and encourage new things; and an equitable and open working climate.

Control variables. Based on the previous literature [58], we considered firm age, firm size, and R&D intensity as the control variables. Firm age was measured using the natural logarithm of the years of company establishment and we used the number of employees to measure firm size with five ordinal categorical variables. R&D intensity [83] refers to the investment in the company's new product, including R&D personnel (the percentage of all employees) and R&D expenditure (the percentage of total revenues).

3.3. Common Method Biases

Common method biases (CMB) are widely present in questionnaire methods. It is a variation derived from measurement methods rather than research constructs, common method variance due to common sources or raters, item characteristics, item context, and measurement context. Common method bias has potentially serious effects on research findings [87]. Therefore, this study uses Harman's single-factor test method to test the common method bias problem, which involves conducting exploratory factor analysis on all items of the questionnaire and examining the unrotated first-factor solution. The first principal component in the total explained variance is 28.62% less than the threshold value of 40%. Therefore, there is no serious common method bias issue in the study's data set.

3.4. Analytical Method

In this study, we used SPSS 26.0 and AMOS 26.0 software to analyze the sample data. First, we reported the reliability and validity, descriptive statistics, and correlation of measurement; construct validity was assessed using confirmatory factor analysis (CFA). Second, according to the method proposed by Baron and Kenny [88], we tested the hypothesis through regression analysis. Finally, we tested the moderated mediating effect using the SPSS macro-PROCESS, as suggested by Hayes [89].

4. Empirical Results

4.1. Reliability and Validity

To test the construct validity of our measurement, we used AMOS 26.0 for confirmatory factor analysis (CFA). We evaluated measurement models that included all five latent variables and showed that the measurement models fit the data well, with $\chi^2/\mathrm{df} = 1.977$ (less than 2), $p < 0.0001$, RMSEA = 0.07 (less than 0.08), SRMR = 0.045 (less than 0.05), CFI = 0.958, NFI = 0.919, RFI = 0.901, and TLI = 0.948 (all greater than 0.9) [90]. All fit indices have reached the ideal level, demonstrating that the construct validity is satisfactory. Table 1 shows the measurement items, factor loading, Cronbach's alpha, composite reliability (CR), and the average variance extracted (AVE).

The reliability of the measures is assessed using Cronbach's alpha coefficient and CR, which must exceed the recommended value of 0.7 [91]. Cronbach's alpha values ranged from 0.866 to 0.925 and CR values ranged from 0.868 to 0.923, all above 0.7, showing good internal consistency and reliability.

Convergent validity was assessed considering factor loading and AVE, which should exceed the 0.5 threshold. Each item's standardized factor loading ranged from 0.766 to 0.936, and the AVE ranged from 0.659 to 0.773, indicating a high degree of convergent validity.

To assess discriminant validity, the square roots of the AVE of a construct should exceed the correlation coefficients between that construct and the other constructs in the model [91]. The results shown in Table 2 suggest that the square roots of all constructs had AVE values ranging from 0.812 to 0.879, all of which are larger than the correlation coefficients between constructs in the model, indicating a good discriminant validity in this measurement model. Overall, we can conclude that the model has sufficient reliability and validity.

Table 1. Reliability and validity analysis.

Construct	Items	Factor Loading	Cronbach's Alpha	CR	AVE
incremental innovation (II)	II1	0.846	0.909	0.911	0.773
	II2	0.936			
	II3	0.852			
radical innovation (RI)	RI1	0.885	0.891	0.895	0.739
	RI2	0.798			
	RI3	0.893			
supportive culture (SC)	SC1	0.878	0.926	0.923	0.763
	SC2	0.909			
	SC3	0.907			
	SC4	0.795			
innovation speed (IS)	IS1	0.853	0.866	0.868	0.687
	IS2	0.853			
	IS3	0.779			
competitive advantage (CA)	CA1	0.783	0.905	0.906	0.659
	CA2	0.848			
	CA3	0.831			
	CA4	0.766			
	CA5	0.827			

Table 2. Descriptive statistics and correlation matrix.

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
competitive advantage	3.719	0.693	*0.812*								
innovation speed	3.571	0.749	0.744 **	*0.829*							
incremental innovation	5.549	1.031	0.522 **	0.495 **	*0.879*						
radical innovation	5.260	1.202	0.519 **	0.567 **	0.604 **	*0.860*					
supportive culture	5.450	1.122	0.527 **	0.495 **	0.657 **	0.550 **	*0.875*				
Age	1.081	0.369	0.023	−0.080	−0.095	−0.081	−0.141 *	1.000			
Scale	2.930	1.233	0.108	0.100	0.010	0.123	0.057	0.490 **	1.000		
RDP	3.140	2.456	0.285 **	0.301 **	0.272 **	0.217 **	0.292 **	−0.062	0.073	1.000	
RDE	2.870	1.310	0.274 **	0.336 **	0.276 **	0.239 **	0.272 **	0.014	0.152 *	0.540 **	1.000

Note(s): 1. N = 201; * $p < 0.05$, ** $p < 0.01$ (two-tailed tests). 2. Entry on the diagonal with italics is the square root of average variances extracted (AVE).

4.2. Descriptive Statistics and Correlation Analysis

Table 2 displays variable means, standard deviations, and Pearson correlations. The variables' correlation coefficients are less than 0.8, which means the study satisfies the statistical criteria. The results show that incremental innovation (β = 0.522, $p < 0.01$), radical innovation (β = 0.519, $p < 0.01$), supportive culture (β = 0.527, $p < 0.01$), and innovation speed (β = 0.744, $p < 0.01$) are statistically significantly correlated with competitive advantage. In addition, control variables other than age and scale, such as R&D personnel (β = 0.285, $p < 0.01$) and R&D expenditure (β = 0.274, $p < 0.01$), also show a statistically significant correlation with competitive advantage. Overall, these results provide preliminary support for our hypothesis. In addition, we calculate the value of the variance inflation factor (VIF) of each model to assess multicollinearity. The VIF value of each model is well below 10, indicating that there is no serious collinearity problem. At the same time, to avoid the interference of collinearity, we perform multiple regression analysis with all latent variables being mean-centered [92].

4.3. Hypotheses Testing

　　To test mediating effects, we employed the hierarchical multiple regression method; for testing the moderated mediating effect, we used the bootstrap technique. Table 3 presents the results of the regression analysis. In terms of control variables, the results in model 1 and model 3, except for firm age and scale, R&D personnel ($\beta = 0.156$, $p < 0.05$), and R&D expenditure ($\beta = 0.236$, $p < 0.01$), are statistically significant and positive on innovation speed. Otherwise, R&D personnel ($\beta = 0.194$, $p < 0.05$) is statistically significant and positive on competitive advantage.

Table 3. Results of regression analyses on mediating effects.

Variables	Competitive Advantage		Innovation Speed		Competitive Advantage
	M1	**M2**	**M3**	**M4**	**M5**
age	−0.002 (0.146)	0.075 (0.125)	−0.132 (0.154)	−0.051 (0.132)	0.107 * (0.100)
scale	0.070 (0.044)	0.014 (0.038)	0.118 (0.047)	0.049 (0.040)	−0.017 (0.030)
RDP	0.194 * (0.023)	0.111 (0.019)	0.156 * (0.024)	0.082 (0.021)	0.060 (0.016)
RDE	0.159 (0.043)	0.055 (0.037)	0.236 ** (0.045)	0.139 * (0.039)	−0.031 (0.030)
II		0.300 *** (0.048)		0.195 ** (0.051)	0.178 ** (0.039)
RI		0.305 *** (0.042)		0.388 *** (0.045)	0.063 (0.036)
IS					0.622 *** (0.054)
F	5.829 ***	18.545 ***	8.565 ***	21.251 ***	41.011 ***
R^2	0.106	0.365	0.143	0.397	0.598
Adjusted R^2	0.088	0.345	0.126	0.378	0.584

Note(s): 1. $N = 201$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two-tailed tests).

4.3.1. Direct Effect Analysis

　　As shown in Table 3, the coefficients for incremental innovation ($\beta = 0.300$, $p < 0.001$) and radical innovation ($\beta = 0.305$, $p < 0.001$) in model 2 are significant and positive on competitive advantage. Thus, H1a and H1b are supported.

4.3.2. Mediating Effect Analysis

　　Baron and Kenny [88] suggest testing the mediation. First, the independent variable has a significant impact on the dependent variable. According to model 2, the estimated coefficient of incremental and radical innovation has a positive and statistically significant effect on competitive advantage. Second, the independent variable must be significantly correlated with the mediating variable. Model 4 indicates that incremental innovation ($\beta = 0.195$, $p < 0.01$) and radical innovation ($\beta = 0.388$, $p < 0.001$) on innovation speed is positive and statistically significant. Third, the mediating variable must be significantly associated with the dependent variable. Model 5 indicates that innovation speed ($\beta = 0.622$, $p < 0.001$) has a significant impact on competitive advantage. Fourth, once the mediating variable has been included in the model, a significant independent variable suggests that the mediating variable only plays a partial mediating role; a non-significant independent variable suggests that the mediating variable plays a complete mediating role. In model 5, the coefficient for incremental innovation is significant and decreased from 0.300 to 0.178 ($p < 0.01$). However, the coefficient for radical innovation is not significant and decreased from 0.305 to 0.063 ($p < 0.1$). From the above four-step regression analysis results, we can suggest that innovation speed partially mediates incremental innovation and competitive advantage, while innovation speed completely mediates radical innovation and competitive advantage. Thus, H2a and H2b are supported.

　　Additionally, we perform a bootstrap analysis (a bootstrap sample of 5000 cases with a 95% confidential interval (CI)) using the PROCESS software to further test the robustness of the mediation effect. When the 95% confidence interval (CI) does not include zero, it is inferred that the mediating effect is significant; otherwise, the mediation effect is not supported [89]. We adopted Model 4 to test the mediation effects. Regarding the mediator

of innovation speed, the results are displayed in Table 4. The indirect effect of incremental innovation on competitive advantage through innovation speed was statistically significant (indirect effect = 0.176, SE = 0.033, 95% CI [0.114, 0.242]). The indirect effect of radical innovation on competitive advantage through innovation speed was statistically significant (indirect effect = 0.189, SE = 0.029, 95% CI [0.138, 0.250]). None of the 95% confidence intervals include zero. Considering the above studies, we can conclude that innovation speed plays a mediating role between incremental and radical innovation and competitive advantage. Thus, hypotheses H2a and H2b are confirmed.

Table 4. Mediation effect bootstrap test.

	Dependent Variable: Competition Advantage				
Independent Variable	**Effect Type**	**Value**	**Boot SE**	**Bootstrap 95% CI**	**Rate (%)**
II	Total effect	0.310	0.041	[0.229, 0.391]	100
	Direct effect	0.134	0.035	[0.002, 0.656]	43.22
	Indirect effect	0.176	0.033	[0.114, 0.242]	56.78
RI	Total effect	0.273	0.036	[0.203, 0.344]	100
	Direct effect	0.084	0.033	[0.020, 0.149]	30.80
	Indirect effect	0.189	0.029	[0.138, 0.250]	69.20

Note: 95% CI, bias-corrected confidence intervals.

4.3.3. Moderated Mediating Effect Analysis

Following the suggestions of previous studies [89], we utilized the PROCESS procedure developed by Hayes, based on 95% bias-corrected confidence intervals, constructed through 5000 bootstrapped samples to test the moderated mediation effects. PROCESS is an observed variable OLS and logistic regression path analysis modeling tool. We estimate direct and indirect effects by relying on the principles of ordinary least squares regression, as well as detecting simple slopes and regions of significance for interaction and conditional indirect effects in the moderated mediation model by calculating bootstrap confidence intervals. We adopted PROCESS Model 7 to test the moderated mediation effects. The results are illustrated in Tables 5 and 6.

Table 5. Results for moderated mediation model with incremental innovation.

Variables	Innovation Speed (Mediator)		Competitive Advantage	
	b (SE)	**95% CI**	**b (SE)**	**95% CI**
constant	3.181 (0.168)	[2.849, 3.513]	1.394 (0.204)	[0.992, 1.798]
Main effects				
II	0.199 ** (0.055)	[0.092, 0.307]	0.135 *** (0.035)	[0.066, 0.203]
SC	0.178 *** (0.052)	[0.075, 0.282]		
IS			0.596 *** (0.051)	[0.497, 0.695]
Interaction effects				
II × SC	0.102 *** (0.037)	[0.029, 0.175]		
R^2	0.363		0.596	
F	15.714 ***		47.67 ***	
IMM	0.061	[0.021, 0.109]		

Note: 1. $N = 201$; ** $p < 0.01$, *** $p < 0.001$ (two-tailed tests). 2. Coefficients are unstandardized. 3. 95% CI, bias-corrected confidence intervals.

We first examined the moderated mediation model with incremental innovation as the independent variable. As shown in Table 5, the effect of incremental innovation on innovation speed is significant and positive (b = 0.199, SE = 0.055, 95% CI [0.090, 0.307]); the interaction terms incremental innovation and supportive culture are significant and positive (b = 0.102, $p < 0.05$, 95% CI [0.029, 0.175]). Thus, H3a was supported. Notably, the index of moderated mediation (IMM) is also significant (IMM = 0.061, SE = 0.023, 95% CI [0.021, 0.109]), which is a direct quantification of the linear form of the association between
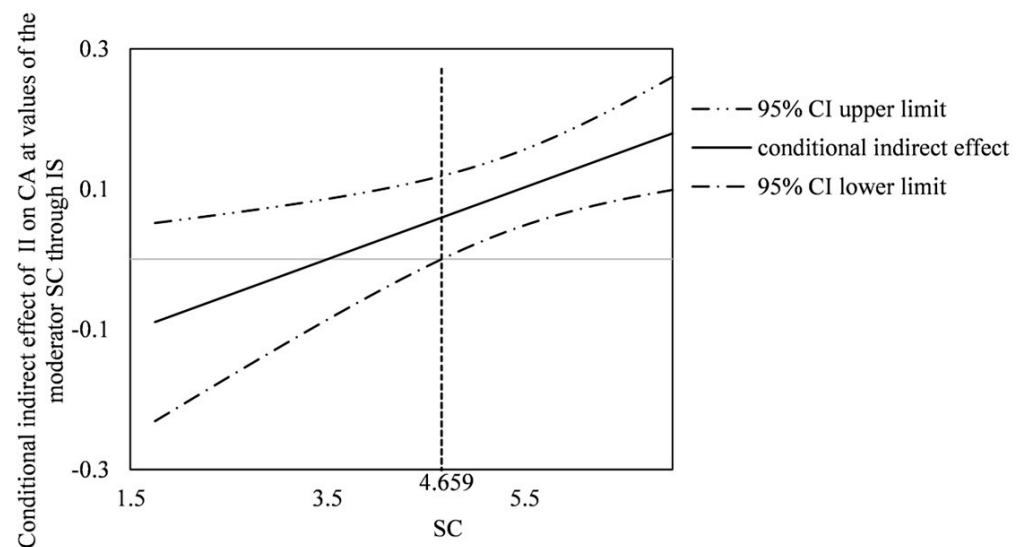
indirect effects and moderators [93]. As the confidence interval (CI) does not include zero and the index is positive, we infer that the conditional indirect effect of incremental innovation on competitive advantage through innovation speed is positively moderated by supportive culture, indicating that as supportive culture increased, the positive effect of incremental innovation on competitive advantage through innovation speed would be enhanced. Therefore, H4a was supported.

Table 6. Results for moderated mediation model with radical innovation.

Variables	Innovation Speed (Mediator)		Competitive Advantage	
	b (SE)	95% CI	b (SE)	95% CI
Constant	3.232 (0.160)	[2.914, 3.548]	1.349 (0.218)	[0.921, 1.779]
Main effects				
RI	0.219 *** (0.043)	[0.134, 0.303]	0.085 * (0.033)	[0.021, 0.150]
SC	0.171 ** (0.047)	[0.079, 0.263]		
IS			0.606 *** (0.054)	[0.499, 0.714]
Interaction effects				
RI × SC	0.078 * (0.031)	[0.017, 0.139]		
R^2	0.423		0.580	
F	20.169 ***		44.560 ***	
IMM	0.047 (0.018)	[0.017, 0.086]		

Note: 1. N = 201; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two-tailed tests). 2. Coefficients are unstandardized. 3. 95% CI, bias-corrected confidence intervals.

To better clarify the interactions, we used the Johnson–Neyman technique [89] to calculate the regions of significance to provide a simple slope test for the moderated relationship. The significance region is described as the point at which the confidence interval is wholly above or below 0. As illustrated in Figure 2, regions of significance showed that, for non-centered 7-point supportive culture values above 4.659, 77.61% of cases fall within the significance regions. These results indicate that the indirect positive relation between incremental innovation and competitive advantage through innovation speed becomes significant. This provides support for H4a.

Figure 2. Conditional indirect effect of incremental innovation on competitive advantage at values of the moderator supportive culture through the mediator innovation speed.

We next examined the moderated mediation model with radical innovation as the independent variable. As shown in Table 6, the interaction terms radical innovation and supportive culture are significantly related to innovation speed, b = 0.078, SE = 0.031, 95% CI [0.017, 0.139]; the confidence interval for the regression coefficient of the product of radical innovation and supportive culture does not include zero. Thus, H3b was supported. The index of moderated mediation (IMM) is significant and positive (IMM = 0.047, SE = 0.018, 95% CI [0.017, 0.086]), the confidence interval does not include zero, and the upper bound is positive. Therefore, we infer that the conditional indirect effect of radical innovation on competitive advantage through innovation speed is positively moderated by supportive culture, indicating that as supportive culture increases, the positive effect of radical innovation on competitive advantage through innovation speed would be enhanced. Therefore, H4b was supported.

Using the Johnson–Neyman technique to discern the nature of the significant interaction, the regions of significance showed that (see Figure 3), for non-centered 7-point supportive culture values above 4.255, 85.07% of cases fall within the significance regions. These results indicate that the indirect positive relation between radical innovation and competitive advantage through innovation speed becomes significant. This provides support for H4b.
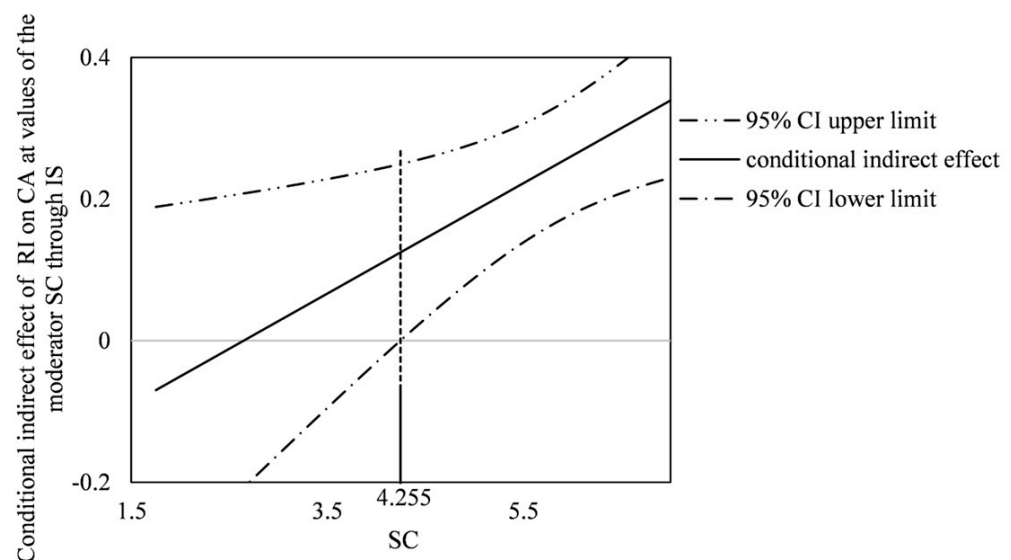
Figure 3. Conditional indirect effect of radical innovation on competitive advantage at values of the moderator supportive culture through the mediator innovation speed.

5. Discussion

This study analyses the intrinsic mechanisms and boundary conditions of incremental and radical innovation on competitive advantage, to explore how firms can enhance their competitive advantage in a dynamic environment. Based on the empirical analysis of survey data from 201 Chinese firms, we find that incremental and radical innovations enhance firms' competitive advantage and that innovation speed mediates the relationship between incremental and radical innovations and competitive advantage. Meanwhile, a supportive culture reinforces the positive impact of incremental and radical innovation on innovation speed. Furthermore, we constructed a moderated mediate model to explore a conditional indirect effect. The results show that a higher level of supportive culture strengthens the mediating effect of innovation speed on the relationship between incremental and radical innovation and competitive advantage. Table 7 shows the statistical results of all the hypotheses tests. Theoretical contributions, practical implications, limitations, and future research are discussed below.

Table 7. Statistical results of hypotheses.

Hypotheses	Result
H1a. *Incremental innovation has a positive impact on competitive advantage.*	Supported
H1b. *Radical innovation has a positive impact on competitive advantage.*	Supported
H2a. *Innovation speed mediates the relationship between incremental innovation and competitive advantage.*	Supported
H2b. *Innovation speed mediates the relationship between radical innovation and competitive advantage.*	Supported
H3a. *Supportive culture positively moderates the relationship between incremental innovation and innovation speed.*	Supported
H3b. *Supportive culture positively moderates the relationship between radical innovation and innovation speed.*	Supported
H4a. *Supportive culture positively moderates the mediating role of innovation speed between incremental innovation and competitive advantage.*	Supported
H4b. *Supportive culture positively moderates the mediating role of innovation speed between radical innovation and competitive advantage.*	Supported

5.1. Theoretical Implications

This study makes several theoretical contributions. First, this study provides rigorous direct empirical support for the view that incremental and radical innovations contribute to competitive advantage. Although the relationship between incremental and radical innovation and competitive advantage is well supported from various perspectives (e.g., financial performance [57], business performance [56], and firm performance [17]), there is little direct empirical evidence of this relationship [7]. Our empirical results confirm that incremental and radical innovations have a significant positive impact on competitive advantage. Moreover, we find that radical innovation has a greater impact on a firm's competitive advantage, supporting the idea that a firm's possession of new and unique technological resources can help it gain a sustainable competitive advantage [94].

Second, this study reveals the mediating role of innovation speed in the relationship between incremental and radical innovation and competitive advantage; the findings contribute to the understanding of the importance of innovation speed in the innovation process of firms. On the one hand, the results suggest that innovation speed plays a partial mediating role between incremental innovation and competitive advantage. This supports the argument of Lin et al. [95] that accelerating incremental innovation can lead to a temporary competitive advantage for firms. On the other hand, the study found that innovation speed plays a fully mediating role between radical innovation and competitive advantage. This further confirms that speed-to-market radical innovations lead to a first-mover advantage and significant gains for firms [30]. As Cankurtaran et al. [33] argued, the timing of a new product's entry into the market is critical, because missing a strategic window of opportunity can result in devastating opportunity costs [96].

Third, this study enriches the literature on organizational culture and innovation by uncovering the boundary conditions of a supportive culture. Our findings suggest that supportive culture positively moderates incremental and radical innovation and competitive advantage and that the moderating role is mediated by influencing the relationship between incremental and radical innovation and innovation speed. A supportive culture creates a trusting and safe organizational climate that helps foster teamwork and promotes knowledge-sharing and creativity [43]. Employees' knowledge, experience, and skills can be more effectively transformed into resources for enterprise innovation. Therefore, the higher the degree of supportive culture in an enterprise, the more willing employees are to participate in innovation, which greatly improves the efficiency of incremental and radical innovation. The findings further support the view that organizational cultural context influences the relationship between innovation and competitive advantage [2,97].

5.2. Practical Implications

This study has several important practical implications. First, given the characteristics of low risk and fast returns for incremental innovation and high risk, as well as high benefits for radical innovation, firms should formulate incremental and radical innovation strategies flexibly to respond to changing market demands and competitive environments, to achieve

a sustainable competitive advantage. Radical innovation can evolve into incremental innovation, while sustained incremental innovation can lead to radical innovation [19]. To better manage incremental and radical innovation, enterprises can set up communication platforms to acquire external knowledge, experience, and customer needs. At the same time, enterprises should increase investment in technological research and development, set up incentive mechanisms for innovation, attract and retain excellent talents, and improve innovation capability and innovation efficiency. Companies that fail to develop both radical and incremental innovation may be missing important opportunities for competitive success [98]. Second, to cope with the changing environment and limited resources, firms should adjust their resource allocation and strategies to increase innovation speed promptly. Managers must recognize the importance of speed-to-market in reducing costs and achieving a return on investment, whether the innovation is incremental or radical. Third, companies should focus on developing a strong internal culture, providing employees with an effective communication platform and skills training programs, encouraging employee learning and knowledge sharing and supporting employee innovative behaviors, to mobilize employee motivation and creativity, which is beneficial to improving the efficiency of incremental and radical innovation.

This study also provides some useful insights for policymakers. On the one hand, the government could provide financial support to encourage enterprises to provide relevant training courses and seminars on innovation capacity enhancement, to improve the innovation capacity and awareness of their employees, encourage enterprises to implement innovation-incentive mechanisms to support employee innovation, and actively and effectively achieve incremental innovation of enterprises to meet market demand. On the other hand, the government can promote cooperation among enterprises, universities, and scientific research institutions to facilitate the exchange of knowledge and technology, accelerate technological research and breakthroughs in key areas, and achieve radical innovations to create first-mover advantages.

5.3. Limitations and Future Research

Although this study makes several contributions to theory and practice, there are also several limitations. First, this study focuses on firms in China, which may limit the generalizability of the results to other regional or national contexts. It would be desirable and interesting to conduct similar studies elsewhere. Second, this study collected cross-sectional data using a questionnaire, which cannot explain the dynamic causal relationships, and future studies could use a longitudinal research design to explore the effects of incremental and radical innovation on competitive advantage at different stages of a firm's life cycle. Moreover, when conducting questionnaires, there may be a social desirability bias, which is a limitation of self-reported data. Therefore, future studies may consider including both positive and negative statements in the questionnaire or a separate evaluation of independent variables and dependent variables to avoid such problems. Third, this study only considered the mediating effect of innovation speed; future studies could consider introducing other variables such as innovation quality and the interaction of innovation speed and quality [99]. In addition, some studies have shown that the results of incremental innovation have an impact on firms' radical innovation performance [100]; future research could consider using radical innovation as a mediator to explore the impact of incremental innovation on firms' competitive advantage. Fourth, this study only examined the moderating effect of supportive cultures; future research could explore additional contextual factors such as bureaucratic and innovative cultures [79]. Overall, future studies could consider introducing these variables to substantiate and extend our study.

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