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Research on the Impact Mechanism of Knowledge Spillover on the Growth of Small and Medium-sized Sports Enterprises

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Abstract

Background and Aim: In recent years, knowledge spillovers and enterprise innovation have become key drivers of the rapid development of small and medium-sized sports enterprises (SMEs) in China. This study conducted a questionnaire survey of 405 employees from SMEs using the snowball sampling method. The study focuses on how knowledge spillovers affect the development of SMEs in the sports industry and verifies the intrinsic links between knowledge spillovers, product innovation, model innovation, learning organizations, and firm growth variables.

Materials and Methods: The study utilized SPSS 26.0 and AMOS 26.0 software for EFA and CFA. Additionally, the research hypotheses were tested using structural equation modeling with AMOS 26.0 software.

Results: 1) Knowledge spillover, product innovation, model innovation, and learning organization all significantly enhance firm growth. 2)Learning organization, product innovation, and model innovation in SME sports enterprises mediate the effect of knowledge spillover on firm growth. 3)Learning organizations and product innovation, learning organizations, and model innovation in SMEs' sports enterprises jointly mediate the impact of knowledge spillovers on firm growth. 4)The study's results provide an in-depth analysis of how knowledge spillovers affect the development of SMEs through direct and indirect paths. This enriches the theory of sports enterprise development and helps promote enterprise growth.

Conclusion: 1) Knowledge spillovers from SMEs directly boost enterprise growth. 2)Knowledge spillovers from SMEs can also indirectly enhance enterprise growth through factors like product innovation, model innovation, and learning organization. 3)Knowledge spillovers can further indirectly facilitate enterprise growth by influencing factors like enterprise learning organization, product innovation, and model innovation.

Keywords: Small and Medium-sized Sports Enterprises (SMEs); Knowledge Spillover; Learning Organization; Product Innovation; Model Innovation

Introduction

Chinese sports enterprises have rapidly developed in recent years, playing a crucial role in driving economic and social progress and transforming the sports industry. However, the internal mechanisms of SMEs are unclear, hindering the identification of core innovation elements. The development of SMEs and the orderly flow of corporate innovation resources have made knowledge spillover a crucial factor influencing the growth of these enterprises. In addition, knowledge spillover encourages SMEs to establish learning organizations. Through knowledge sharing, enterprises can quickly acquire new knowledge, technologies, and ideas, accelerating the integration of corporate resources. This process enables mutual benefit and win-win outcomes through product and model innovation, providing more development

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opportunities and competitive advantages. Consequently, it helps SMEs grow healthily (Sun et al., 2018; Jiang et al., 2020). Existing studies have primarily focused on traditional enterprises and examined representative enterprises or industrial clusters, with limited research specifically addressing SMEs. Additionally, as a relatively new industry, the sports sector has seen limited research on the intrinsic mechanisms influencing the development of sports enterprises. There is a notable lack of in-depth studies on the growth mechanisms of these enterprises. Based on this, this paper focuses on SMEs to explore the intrinsic mechanism of knowledge spillover on their growth. It introduces three intermediary variables—learning organization, product innovation, and model innovation—and analyzes how knowledge spillover influences the growth of these enterprises. This study aims to investigate the factors influencing the growth of SMEs. It seeks to uncover the mechanisms underlying the impact of knowledge spillovers, learning organizations, product and model innovation, and firm growth. Additionally, it explores ways to enhance knowledge spillovers in SMEs to promote their growth.

Research hypothesis

Knowledge spillover acts as a catalyst for new ideas and applications, representing a crucial aspect of knowledge reengineering and a key area in the field of new economics. From the perspective of evolutionary economics, Tong et al. (2019) proposed that in the development process of enterprises, each enterprise's growth does not occur in isolation but is influenced by other enterprises. Knowledge spillover is closely linked to the economic growth of enterprises. Based on U.S. data, studies such as Keller and Yeaple (2009) demonstrate that significant knowledge spillover effects can enhance the productivity of related enterprises and promote corporate growth. High-quality knowledge spillovers can enhance the likelihood of corporate growth through participation in collaborative R&D efforts. Wei et al. (2019) emphasized that knowledge spillovers generated through cooperative R&D and joint invention can synergistically lead to breakthrough growth and innovation within enterprises. Through an empirical study conducted in Nigeria. The knowledge spillover primarily occurs through the transfer of human resources, cooperation, and training among enterprises. This facilitates the recipient enterprises to derive benefits and foster enterprise growth. Several studies have shown that knowledge spillovers can contribute to business development. However, there are no studies specifically focusing on SMEs in the sports industry. Consequently, it remains uncertain whether SMEs in sports are affected by knowledge spillovers. Building upon this, the study proposes the following hypotheses:

H1: Knowledge spillovers in SMEs have a substantial impact on the growth of sports enterprises.

A learning organization is a cultural phenomenon, and it optimizes corporate culture and employee behavior. Watkins and Marsick (2023) concentrated on the attributes of learning organizations and delineated seven distinct characteristics. The research concluded that learning organizations play a significant role in promoting enterprise development. From the perspective of corporate learning organizations, discrete and continuous game models were constructed in 2016 to analyze the relationship between corporate employees and the company.

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They found a significant correlation between learning organizational culture and organizational commitment, organizational member behavior, and knowledge sharing. Learning organization is a new concept, and the relationships between knowledge spillovers, learning organizations, product innovation, model innovation, and firm growth have not been discussed in depth in existing studies. Additionally, no scholars have examined the role of learning organizations as a mediating variable between knowledge spillovers and firm growth. Building upon this, the study presents the following hypotheses:

H2: Knowledge spillovers in SMEs have a significant impact on learning organizations.

H3: Learning organizations in SMEs have a significant impact on enterprise growth.

H8: Learning organizations in SMEs have a significant impact on enterprise product innovation.

H9: Learning organizations in SMEs have a significant impact on enterprise model innovation.

H10: Learning organizations in SMEs play a mediating role in the impact of knowledge spillovers on enterprise growth.

The creation and dissemination of internal knowledge within an enterprise have emerged as key factors in recent years. Soriano and Montoro-Sanchez (2011) conducted an empirical study on 784 innovative enterprises in Spain, revealing that knowledge spillover can enhance the innovation tendency of enterprises, prompting them to increase investment and foster growth. From the perspective of enterprise innovation, enterprise innovation encompasses both product innovation and model innovation. Akcigit et al. (2021) suggest that the impact of knowledge spillover is more pronounced at the basic research level than at the applied research level. The carriers of knowledge spillover consist of high-end elements such as human capital and information. They suggest that these elements can enhance the allocation efficiency of high-end resources within and between industries, ultimately improving enterprise production efficiency through sharing, matching, and learning effects. Studies have been conducted on the impact of knowledge spillovers on firm innovation, which encompasses various aspects such as product innovation and model innovation. However, existing research tends to provide a general overview of innovation without detailed analysis. This study categorizes innovation in SMEs into product innovation and model innovation and specifically examines the impact of knowledge spillovers on product innovation. Building upon this, the study proposes the following hypotheses:

H4: Knowledge spillovers in SMEs have a significant impact on product innovation.

H5: Knowledge spillovers in SMEs have a significant impact on model innovation.

Hong (2013) contends that the essence of enterprise innovation lies in technological innovation, which aims to achieve higher resource allocation efficiency by leveraging knowledge, technology, systems, and business model innovations to reorganize existing material resources, leading to endogenous growth with maximum efficiency. On the other hand, according to Baumol (1990), innovation in sports enterprises primarily manifests as product innovation. Meanwhile, enterprise innovation involves the entire process of utilizing internal and external resources to recombine and generate knowledge. This process encompasses not only the investment required to acquire new knowledge but also the production of new technologies and

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products as carriers. Moreover, it includes innovation input-output efficiency, representing the entire process from the generation of new technologies, products, and services to the realization of added economic value. Studies have explored the contribution of business innovation to firm growth. However, they often do not delve into the in-depth mechanisms of this impact. This study analyzes the effect of knowledge spillovers on firm growth, using product innovation, model innovation, and learning organizations as mediating variables. Additionally, it constructs and verifies the influence paths of two-chain mediators. Building upon these perspectives, the study proposes the following hypotheses:

H6: Product innovation in SMEs has a significant impact on corporate growth.

H7: Model innovation in SMEs has a significant impact on corporate growth.

H11: Product innovation in SMEs plays a mediating role in the impact of knowledge spillovers on enterprise growth.

H12: Model innovation in SMEs plays a mediating role in the impact of knowledge spillovers on enterprise growth.

H13: Learning organizations and product innovation in SMEs play a mediating role in the impact of knowledge spillovers on enterprise growth.

H14: Learning organizations and model innovation in SMEs play a mediating role in the impact of knowledge spillovers on enterprise growth.

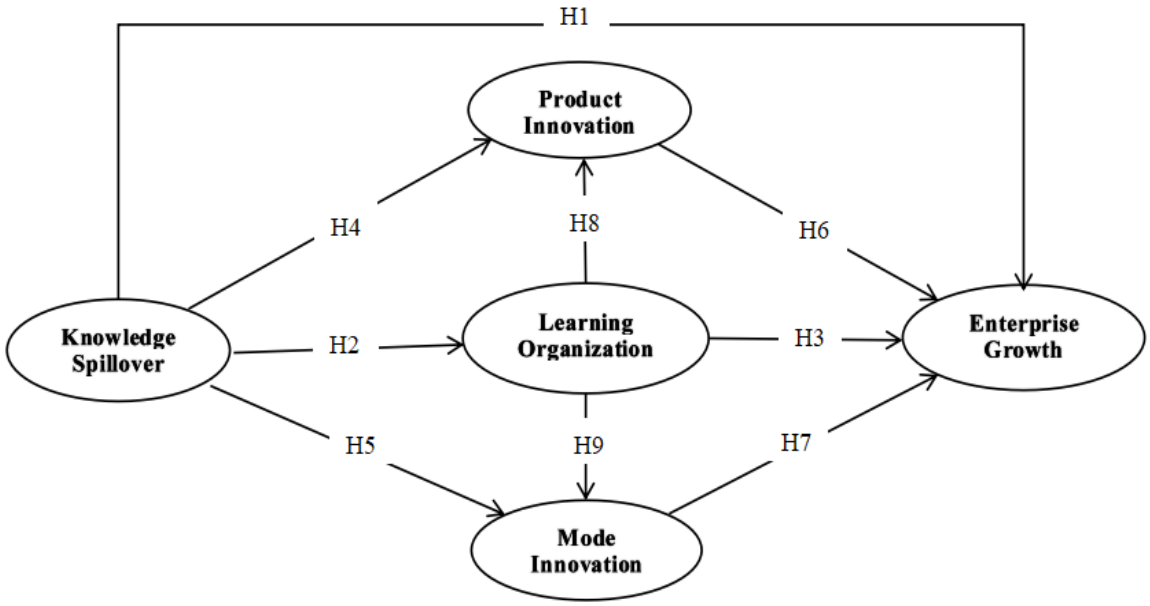

Figure 1 Theoretical model of the impact mechanism of knowledge spillover on the growth of SMEs

Methodology

Subjects

Shandong Province hosts several industrial clusters of small and medium-sized sports enterprises, such as the Dezhou Sporting Goods Manufacturing Cluster and the Qingdao Sports Industrial Park, which align with the objectives of this research study. First, the group conducted field visits and research by contacting sports government departments and sports

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enterprise leaders in various cities of Shandong Province to understand the current development status of small and medium-sized sports enterprises (SMEs) in the region. Then, a scale was prepared and an electronic questionnaire was created using the 'Questionnaire Star' platform. Finally, from October to December 2023, an online survey was conducted among employees of SMEs in Shandong Province using the 'snowball' sampling method. A total of 423 questionnaires were collected. After eliminating invalid questionnaires, 405 valid questionnaires remained. Among the respondents, there were 209 males and 196 females. In terms of educational background, 165 had below high school (or junior college) education, 174 were undergraduates (or junior college graduates), and 66 held a master's degree or higher. Furthermore, the distribution of job roles included 26 top-level managers, 34 middle-level managers, 56 technical researchers and developers, 101 salespersons, and 188 shop floor workers in the enterprises. To prevent systematic errors caused by factors such as the same data source, measurement environment, or measurement tools, which could make the study's conclusions inaccurate and affect its validity and reliability, this study employed a common method bias test. The data ultimately passed the test, verifying its validity.

Research Tools

Scale design

An initial questionnaire covering the five dimensions of knowledge spillover, learning organization, product innovation, model innovation, and corporate growth was compiled by drawing on expert interviews, mature scales, and existing research results. The knowledge spillover scale draws on the research results of Almeida and Kogut (1999) and Gulati et al (2000), with a total of 7 items; product Innovation Scale Mainly refers to the research results of He and Wong (2004), a total of 5 items; model innovation mainly refers to the research results of scholars Wang et al. (2021), a total of 5 items; learning organization mainly refers to Refer to the research results of Edmondson (2002), a total of 6 questions; enterprise growth, based primarily on Gulati et al. (2009), was measured using seven items encompassing technological upgrading, scale expansion, and benefits increase. The scales all use a 7-point Likert scoring method, ranging from "completely disagree" to "completely agree" with scores ranging from 1 to 7.

To ensure the scientificity and rigor of the research, and ensure that the questionnaire items are reasonable and the semantic expression is clear, the questionnaire was initially designed after a literature review and expert discussion, and a small-scale pre-survey was conducted. From June 16, 2023-June 26, 2023, questionnaires were distributed face-to-face to 125 sports enterprise managers, technicians, sales personnel, and workshop staff in Shandong Province, and the questionnaires were collected. In the end, this study collected a total of 125 questionnaires, eliminated invalid questionnaires with missing values, contradictory items, and all the same answers, and obtained 106 valid questionnaires. Of these, 52 were male and 54 female, 8 were under 25 years old, 32 were between 26 and 35 years old, 31 were between 36 and 45 years old, 28 were between 46 and 55 years old, and 7 were over 55 years old.

In the pre-research stage, questionnaires were distributed face-to-face, resulting in the collection of 125 questionnaires, of which 106 were deemed valid, yielding an effective rate of 84.80%. SPSS 26.0 software was employed to assess the reliability and validity of the initial questionnaire. The reliability test utilized Cronbach's alpha coefficient and CITI coefficient analysis. All items in the scale exhibited CITI coefficients exceeding 0.4, indicating satisfactory internal consistency, with an overall value of

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0.946. Specifically, the Cronbach's alpha coefficients for the five dimensions were 0.931, 0.923, 0.932, 0.940, and 0.963, all exceeding 0.9, signifying very high internal consistency. Content validity was evaluated using the expert goal consistency index. Five sports scholars, business executives, and sports government staff were invited to assess the scale items. The goal consistency index (IOC) for all items exceeded 0.5, meeting content validity standards. Validity analysis was conducted through exploratory factor analysis, KMO value, and Bartlett's sphericity test. Factors with eigenvalues greater than 1 were extracted through principal component analysis and the maximum variance method for rotation. A total of 5 factors were extracted, with a cumulative explained variance of 78.074%, surpassing the 60% threshold. Additionally, all items met the requirements of factor loading greater than 0.5 and cross-coefficient less than 0.4 (Table 1).

Table 1 Total variance explained in the pre-survey questionnaire

Element	Initial eigenvalue			Extract the sum of squared loads			Rotating load sum of squares		
	Total	Variance %	Accumulation %	Total	Variance %	Accumulation %	Total	Variance %	Accumulation%
1	11.871	39.569	39.569	11.871	39.569	39.569	5.493	18.310	18.310
2	4.248	14.161	53.730	4.248	14.161	53.730	5.138	17.127	35.437
3	3.106	10.352	64.082	3.106	10.352	64.082	4.775	15.916	51.353
4	2.441	8.137	72.219	2.441	8.137	72.219	4.084	13.615	64.968
5	1.757	5.855	78.074	1.757	5.855	78.074	3.932	13.107	78.074

Reliability and validity analysis

Based on the provided information, the reliability and validity analysis of the formal survey data can be conducted using SPSS 26.0 and AMOS 26.0. Reliability analysis using Cronbach's alpha coefficients indicates that all five dimensions in the scale have coefficients greater than 0.8, signifying very high reliability of the questionnaire scale. Additionally, the analysis of Corrected Item-Total Correlation (CITC) values reveals that all items exhibit values greater than 0.4, indicating a good correlation between the analysis items and demonstrating a high level of reliability for the scale items. Furthermore, conducting an item deletion analysis, where each item is removed individually, shows that Cronbach's alpha coefficient reliability coefficient does not significantly increase after deleting any item. This suggests that the internal consistency of the scale remains high even after the removal of individual items.

Confirmatory factor analysis was conducted on the formal survey data (Tables 2 and 3). The standardized factor loadings of all items were greater than 0.5, the AVE of all variables was greater than 0.5, and the square root of AVE was greater than the correlation coefficient of the row and column, indicating that the scale has relatively good construct validity.

Table 2 Reliability and validity test results of the questionnaire scale on the influence of knowledge spillover on enterprise growth

Dimensions	Question	Standardized coefficient	Unstandardized coefficient	SE	Z	P	CR	AVE
Knowledge	KS1	0.851	1			***	0.942	0.700
Spillover	KS2	0.846	0.978	0.045	21.853	***		

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Dimensions	Question	Standardized coefficient	Unstandardized coefficient	SE	Z	P	CR	AVE
	KS3	0.820	0.920	0.044	20.720	***		
	KS4	0.832	0.946	0.045	21.241	***		
	KS5	0.825	0.957	0.046	20.932	***		
	KS6	0.833	0.958	0.045	21.27 0	***		
	KS7	0.847	1.012	0.046	21,886	***		
	PI1	0.852	1			***		
	PI2	0.856	1.02 0	0.046	22.015	***		
Product Innovation	PI3	0.845	1.013	0.047	21.503	***	0.929	0.724
	PI4	0.865	1.07 0	0.048	22.406	***		
	PI5	0.835	0.971	0.046	21.097	***		
	MI1	0.844	1			***		
	MI2	0.850	0.997	0.047	21.397	***		
Mode Innovation	MI3	0.855	1.019	0.047	21.619	***	0.929	0.723
	MI4	0.853	1.008	0.047	21.533	***		
	MI5	0.848	1.021	0.048	21.332	***		
	LO1	0.865	1			***		
	LO2	0.856	1.001	0.043	23.047	***		
Learning	LO3	0.871	1.001	0.042	23.77	***	0.944	0.738
Organization	LO4	0.856	0.978	0.043	23.005	***		
	LO5	0.863	0.989	0.042	23.348	***		
	LO6	0.844	0.91	0.041	22.411	***		
	EG1	0.875	1			***		
	EG2	0.871	0.960	0.039	24.724	***		
	EG3	0.883	0.999	0.039	25.421	***		
	EG4	0.871	0.983	0.040	24.698	***	0.958	0.763
Enterprise Growth	EG5	0.869	0.972	0.040	24.605	***		
	EG6	0.868	0.983	0.040	24.550	***		
	EG7	0.885	1	0.039	25.535	***		

Note: *** means P < 0.001

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Table 3 Validity analysis results

	Knowledge Spillover	Product Innovation	Mode Innovation	Learning Organization	Enterprise Growth
Knowledge Spillover	0.836				
Product Innovation	0.309	0.851			
Mode Innovation	0.295	0.354	0.850		
Learning Organization	0.280	0.316	0.349	0.859	
Enterprise Growth	0.462	0.465	0.495	0.442	0.877

Note: The diagonal bold value is the square root of the AVE value

Results

Common method deviation test

The common method bias (CMB) test identifies and evaluates systematic errors caused by factors such as the same data source, measurement environment, or measurement tool. It is widely used for testing questionnaire survey data across various fields. CMB is an artificial systematic error between explanatory and validity items that arises from the same sample source or subjects with similar item context and variable characteristics (Podsakoff & MacKenzie, 2003). To address this, the study employed Harman's (1976) single-factor test method to conduct an exploratory factor analysis on all scale items, using principal component analysis to extract 5 factors with eigenvalues greater than 1. The variance explanation rate of the first factor was 17.87% (see Table 1), which is well below the standard threshold of 40%, indicating that common method bias is within an acceptable range (Harman, 1976). Consequently, the impact of common method bias on the study's results can be considered negligible.

Descriptive statistics and correlation analysis

This study utilizes the Pearson correlation coefficient to analyze the correlation between variables and measure the strength of their relationships. SPSS 26.0 statistical software was employed to calculate the Pearson correlation coefficients between the variables. The results are presented in Table 4.

Table 4 Pearson correlation coefficient analysis results

	Knowledge spillover	Model innovation	Product Innovation	Learning Organization	Business growth
Knowledge spillover	0.836				
Model innovation	0.295**	0.851			
Product Innovation	0.309**	0.354**	0.850		
Learning Organization	0.280**	0.349**	0.316**	0.859	
Business growth	0.462**	0.495**	0.465**	0.442**	0.877

Note: ** means $P < 0.01$, indicating significance

Direct effect test

AMOS 26.0 was used to construct a structural equation model, and path analysis was used to test the main effect of the relationship between the variables in the model (Table 5 and Figure 1).

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Table 5 Main effect hypothesis test results

Hypothesis	Path	Unstandardized coefficient	Standardized coefficient	SE	CR	P	Test result
H1	Knowledge Spillover → Enterprise Growth	0.295	0.264	0.050	5.874	<0.001	support
H2	Knowledge Spillover → Learning Organization	0.313	0.298	0.055	5.721	<0.001	support
H3	Learning Organization → Enterprise Growth	0.218	0.205	0.048	4.510	<0.001	support
H4	Knowledge Spillover → Product Innovation	0.254	0.266	0.053	4.800	<0.001	support
H5	Knowledge Spillover → Model Innovation	0.229	0.310	0.053	4.355	<0.001	support
H6	Product Innovation → Enterprise Growth	0.264	0.238	0.051	5.147	<0.001	support
H7	Mode Innovation → Enterprise Growth	0.311	0.282	0.052	5.979	<0.001	support
H8	Learning Organization → Product Innovation	0.255	0.253	0.050	5.068	<0.001	support
H9	Learning Organization → Model Innovation	0.298	0.227	0.051	5.888	<0.001	support

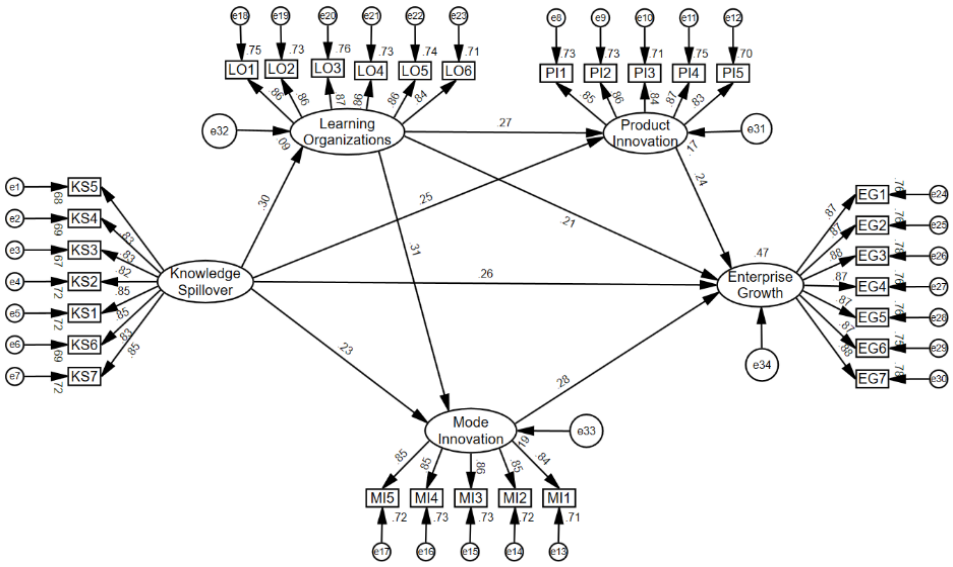

Figure 2 Standardized structural equation model results plot

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Model fit is the difference between the matrix of correlation coefficients (covariance matrix) of the variables derived from the hypothetical theoretical model and the matrix of correlation coefficients (covariance matrix) between the variables obtained from the actual data, i.e. the degree of agreement between the hypothetical theoretical model and the actual data (Iacobuccl, 2010). The higher the model fitting degree, the higher the usability of the model and the more meaningful the parameter estimates are. The research results show that X2/df is 0.953, far lower than the standard of 3; RMSEA is 0.000, less than 0.05; NFI is 0.968, RFI is 0.962, GFI is 0.946, and AGFI is 0.936, all higher than the standard value of 0.9. According to the above model fitting test results, it can be seen that the measurement model of this study passed the model fitting test, and the overall fit of the model is good. The specific results are shown in Table 6.

Table 6 Model fit test

Fit index	X2/df	RMSEA	NFI	RFI	GFI	AGFI
Test value	0.953	0.000	0.968	0.962	0.946	0.936
Reference	< 3	< 0.05	> 0.9	> 0.9	> 0.9	> 0.9

H1 (Knowledge Spillover → Enterprise Growth) is supported. The study results indicate that knowledge spillovers from SMEs have a significant positive impact on enterprise growth. These findings align with previous research (Wu et al., 2022) suggesting a significant association between knowledge spillovers and firm growth. Firstly, knowledge spillovers promote cross-border resource integration of SMEs, enabling them to obtain financial, technological, and talent support to foster enterprise development and growth. This facilitates optimal resource allocation through knowledge and resource sharing, leading to win-win cooperation. Secondly, knowledge spillovers facilitate cross-border exchange and talent cultivation in SMEs. This attracts high-quality talents from other industries, promotes technological innovation and management upgrading, and enhances the comprehensive quality and professional ability of enterprise employees. Thirdly, knowledge spillovers enable SMEs to understand market demand and consumer preferences, refine product positioning, and expand market reach. Simultaneously, they optimize marketing strategies and sales models to enhance market competitiveness. Fourthly, knowledge spillovers drive innovation in SMEs, stimulating their innovation potential and enhancing their innovation capacity.

H3 (Learning Organization→Enterprise Growth) is supported. The study results indicate that learning organizations in small and medium-sized sports firms have a significant positive impact on firm growth. These findings are consistent with previous research (Chen, 2016) suggesting a significant association between learning organizations and enterprise growth. Learning organizations in SMEs in sports enables firms to better adapt to changing market environments and technological trends, allowing them to accurately capture market opportunities and achieve sustained growth. Additionally, these organizations focus on fostering and developing the competencies of their employees, providing them with opportunities to learn and grow, and enhancing their initiative and motivation. Furthermore, learning organizations in SMEs promote knowledge sharing and teamwork, breaking down information and interdepartmental barriers, and improving work efficiency and quality. Finally, they prioritize creating a positive learning culture and an innovative atmosphere, stimulating the creativity and

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innovation of employees, and promoting continuous improvement and innovation.

H6 (Product Innovation → Enterprise Growth）is supported. The study results demonstrate that product innovation in small and medium-sized sports firms has a significant positive impact on firm growth. This finding diverges from the conclusions drawn by Balkin (Balkin et al., 2000) but aligns with the findings of Li (Li & Zhu, 2021), which suggest a significant association between learning organizations and firm growth. Product innovation in SMEs (SMEs) promotes enterprise growth through various mechanisms. Firstly, it expands market share and profit channels. Secondly, it enhances brand value and reputation, thereby improving enterprise competitiveness.

H7 (Mode Innovation → Enterprise Growth）is supported. The study results indicate that model innovation in SMEs has a significant positive impact on firm growth. These findings are consistent with previous research (Wang & Zhou, 2022), which also identified a significant association between model innovation and enterprise growth. The positive impact of model innovation in SME sports enterprises on business growth primarily stems from continuous innovation and improvement in several areas: competitive advantage in the market, brand image enhancement, efficiency and cost optimization, new market development, and cooperation and resource integration. These factors collectively enhance competitiveness, thereby facilitating sustainable business development.

Test of mediating effect

This study used the bias-corrected non-parametric percentile Bootstrap confidence interval method to test the mediating effect existing in the model. The Bootstrap method refers to a method of repeatedly sampling with replacement from the initial sample to obtain samples close to the population distribution (Hayes, 2009). If the confidence interval does not include 0, it means that the mediation effect exists; if the confidence interval of the direct effect does not include 0, it means that the mediation effect is partial mediation; if the confidence interval of the direct effect includes 0, it means that the mediation effect is complete mediation.

This study used the Bootstrap method to resample the sample 5,000 times and test the five mediating effects in the model under the setting conditions of 95% confidence interval. The results of the mediation effect test are shown in Table 7.

"Knowledge Spillover→Learning Organization→Enterprise Growth" shows that the Bias-corrected 95% CI is [0.025, 0.114] and the Percentile 95% CI is [0.023, 0.108], H10 and H2 is supported. The study results indicate that learning organizations mediate the relationship between knowledge spillovers and firm growth in SMEs. These findings are consistent with previous studies (Meng et al., 2023), which also identified an association between learning organizations, knowledge spillovers, and firm growth. Firstly, learning organizations facilitate knowledge acquisition and sharing, which in turn drives business growth. Secondly, they can transform and apply knowledge spillovers to promote corporate growth. Thirdly, learning organizations maintain knowledge innovation and continuous improvement, further contributing to corporate growth. Finally, learning organizations promote knowledge spillover and diffusion, thereby fostering enterprise development.

"Knowledge Spillover→Product Innovation→Enterprise Growth" shows that the Bias-corrected 95% CI is [0.023, 0.114] and the Percentile 95% CI is [0.020, 0.105], H11 and H4 is supported. The results of the study indicate that there is a mediating effect of product innovation in SMEs between knowledge spillovers and firm growth. The results are consistent with previous research findings (Ma,

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2013) that there is an association between product innovation knowledge spillovers and firm growth. The mediating effect of product innovation in SMEs' sports enterprises between knowledge spillover and enterprise growth is mainly because enterprises can promote knowledge spillover and sharing through learning organizations that create a positive innovation culture and atmosphere, maintain close cooperation with their partners, and focus on technological research and development and optimization, which in turn improves the success rate of product innovation, increases market competitiveness and customer loyalty, and realizes the growth of the enterprise.

"Knowledge Spillover→ Model Innovation→Enterprise Growth" shows that the Bias-corrected 95% CI is [0.022, 0.119] and the Percentile 95% CI is [0.020, 0.116], H12 and H5 is supported. The study results indicate that model innovation in SMEs mediates the relationship between knowledge spillovers and firm growth. These findings align with previous studies (Xie & Jiang, 2022), which also identified an association between model innovation, knowledge spillovers, and firm growth. Model innovation in SMEs plays a mediating role between knowledge spillover and enterprise growth primarily by facilitating the acquisition and application of knowledge. This is achieved through the establishment of learning organizations, fostering innovative thinking and mechanisms, paying attention to changes in the external environment and market demand, integrating the industrial chain, and optimizing resource allocation. These actions collectively promote enterprise innovation and growth.

"Knowledge spillover→Learning organization→Product innovation→ Enterprise growth" shows that the Bias-corrected 95% CI is [0.008, 0.041] and the Percentile 95% CI is [0.006, 0.037], H13 and H8 is supported. The study results indicate a chain mediation effect between knowledge spillovers and firm growth through learning organizations and product innovation in SMEs. These findings represent an innovation and breakthrough compared to previous studies (Meng et al., 2023; Ma, 2013; Xie & Jiang, 2022), offering a more comprehensive perspective on the impact of knowledge spillovers on firm growth. The construction of a learning organization helps enterprises acquire and integrate external and internal knowledge resources, cultivate and enhance the learning and innovation capabilities of their employees, and strengthen knowledge sharing and collaboration. This leads to a virtuous cycle and accumulation of knowledge. Based on a learning organization, companies can better innovate their products, continuously develop and improve them, and increase their competitiveness and market share. As an enterprise continues to learn and innovate, it acquires more knowledge and skills, improves product quality and market competitiveness, and attracts more investment and customers. This further enhances the enterprise's strength and scale, enabling a virtuous cycle of growth. "Knowledge spillover→Learning organization→Model innovation→Enterprise growth" shows that the Bias-corrected 95% CI is [0.012, 0.052] and the Percentile 95% CI is [0.010, 0.047], H14 and H9 is supported. The study results suggest a chain mediation effect between knowledge spillovers and firm growth through learning organizations and model innovation in SMEs. This finding integrates and innovates upon previous studies (Liu & Wang, 2023). On one hand, model innovation enables SMEs in sports to improve and upgrade their existing business models, discovering new growth points and business opportunities. Additionally, model innovation helps transform internal knowledge and experience into concrete business practices, further promoting enterprise growth. On the other hand, the construction of learning organizations and the promotion of model innovation facilitate the better integration and application of knowledge and experience within SMEs. This creates a knowledge

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spillover effect within the industry, which can then be disseminated and proliferated through market exchanges, industry collaboration, and the formulation of technical standards, thereby positively impacting the development of SME sports enterprises.

Table 7 Mediation effect test

Parameter	Effect	SE	Bias-corrected 95% CI			Percentile 95% CI		
			Lower	Upper	P	Lower	Upper	P
Knowledge spillover → learning organization → enterprise growth	0.061	0.022	0.025	0.114	0.001	0.023	0.108	0.001
Knowledge spillover → product innovation → enterprise growth	0.060	0.022	0.023	0.114	0.001	0.020	0.105	0.002
Knowledge spillover → Model innovation → Enterprise growth	0.064	0.025	0.022	0.119	0.002	0.020	0.116	0.003
Knowledge spillover → learning organization → product innovation → enterprise growth	0.019	0.008	0.008	0.041	0.000	0.006	0.037	0.001
Knowledge spillover → learning organization → model innovation → enterprise growth	0.026	0.010	0.012	0.052	0.000	0.010	0.047	0.001

Conclusion

1) Knowledge spillovers, product innovation, model innovation, and learning organizations in SMEs can all contribute to organizational growth and development.

2) Knowledge spillovers from SMEs in sports can indirectly contribute to firm development through a single mediating effect of learning organizations, product innovation, and model innovation.

3) Knowledge spillovers from SMEs can contribute to firm growth through learning organizations and product innovation chain mediation effects.

4) Knowledge spillovers from SMEs can contribute to firm growth through learning organizations and model innovation chain mediation effects.

Recommendation

Future research will concentrate on two primary aspects. Firstly, it will expand the scope of research variables. This study predominantly examines the factors and pathways influencing the growth of SMEs in sports, including knowledge spillovers, product innovation, model innovation, and learning organizations. Subsequent studies should delve deeper into additional factors influencing SME growth in sports and thoroughly analyze their underlying causes. Secondly, it will broaden the research scope. This study primarily focused on Shandong Province for its questionnaire survey, potentially influenced by regional factors. Future research should encompass a wider survey area, diversify sample sources, and increase sample sizes for a more comprehensive analysis.

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Ethics approval

This is to certify that the research project identified below has received approval on human research protection by the Human Research Ethics Committee, Stamford International University, which is in full compliance with international guidelines of human research protection of the Belmont Report. (Code: STIU-HRECO52/2024)

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