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The effect of entrepreneurship, dual innovation on firm growth performance under the digitalization perspective: Evidence from China

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Abstract: China's economy is changing from resource-driven to innovation-driven, and how Technology-Based small and medium-sized enterprises, as an active group of innovation, can realize sustainable growth has gradually become an important issue. Based on the resource-based theory, this paper utilizes the survey data of 166 Technology-Based small and medium-sized enterprises in Beijing to develop a research model to establish the interaction effects of entrepreneurship, dual innovation, digitization level and the growth performance of enterprises, and examines the mediating effect of dual innovation and the moderating effect of digitization level. The results show that entrepreneurship has a significant direct positive effect on enterprise growth performance and can indirectly affect enterprise growth performance through dual innovation. Meanwhile, the level of digitization plays a negative moderating role in the influential relationship between entrepreneurship and exploitative innovation, while it plays a U-shaped moderating role in the influential relationship between entrepreneurship and exploratory innovation.

1. Introduction

The report of the 20th Party Congress clearly puts forward that innovation is the first power to lead development, and it is necessary to deeply implement the strategy of strengthening the country with talents and the strategy of innovation-driven development, to stimulate and protect entrepreneurship, and to encourage more social subjects to devote themselves to entrepreneurship. Technology-Based small and medium-sized enterprises (SMEs) have been active in innovation and entrepreneurship activities due to their advantages of outstanding innovation ability and high profit and high growth of high-tech enterprises, and they have become the most innovative and dynamic and innovative group in the group of SMEs (Huang et al., 2017[1]). However, the average survival period of Chinese

Technology-Based SMEs is 4 years (Wang et al., 2012[2]), and most of them "die" at the early stage due to their weak growth ability and insufficient utilization of external resources (Huang et al., 2017[1]), and there is a "strong and weak" situation. Therefore, in order to realize their own growth, Chinese Technology-Based SMEs urgently need to continuously improve their growth performance as the goal, explore effective paths for enterprise growth, and break the bottlenecks restricting the development of enterprises.

The growth and development of enterprises has always been a key topic of discussion and research in enterprises and even in academia. Some scholars believe that the key to enterprise growth lies in the effective utilization of resources (Penross, 1959[3]), and resources with both heterogeneity and dynamism are considered to be the root cause of sustainable enterprise growth (Adner & Helfat, 2003[4]). Entrepreneurship has been increasingly emphasized by both enterprises and academics because of its simultaneous possession of these two qualities. On the one hand, entrepreneurship, as a heterogeneous intangible resource, embodies the potential values and institutional orientation of enterprises, which can directly influence their decision-making preferences and key strategic choices (Chen & Wang, 2010[5]; Nie & Luo, 2019[6]), thus affecting the growth of the enterprise. On the other hand, entrepreneurship is an inexhaustible driving force for the allocation of social resources (Zhang et al., 2021[7]), which can dynamically adjust the resource allocation strategy in the face of internal and external uncertainties, promote continuous innovation (Liu, 2019[8]), achieve competitive advantages (Xi et al., 2019[9]), and ultimately realize the high-quality development of enterprises (Sun et al., 2024[10]). Existing studies have more fully confirmed that entrepreneurship is an important source of motivation to achieve enterprise growth and development, but the specific growth paths through which entrepreneurship affects growth performance are not yet clear. Combing through the literature, it is found that in the studies exploring the growth path of enterprises, most scholars at present, based on the theory of enterprise growth, start from different resources to explore the important impact of the ability to use enterprise resources such as absorptive capacity (Shen, 2022[11]), dynamic capacity (Guo & Hou, 2021[12]), and financing capacity (Gao et al., 2022[13]) on the performance of enterprise growth, and forming a "Resources→Capacity→Performance" as the main logical framework of enterprise growth research paradigm (Gao & Hou, 2021[12]). Therefore, this paper starts from entrepreneurship and explores the growth path of Technology-Based SMEs with the analytical framework of "Resources→Strategy→Performance" based on the resource-based theory, which has stronger practical significance.

The implementation of innovation drive through dual innovation is an important strategy for the sustainable development of enterprises (Lan & Hu, 2024[14]), which specifically includes two different types of innovation activities, exploratory innovation and exploitative innovation, which play an important role in integrating, reorganizing, and making the best use of internal and external resources in the process of enterprise growth (Wang & Rafiq, 2014[15]). For Technology-Based SMEs, especially when facing resource constraints, differentiated allocation of resources according to different innovation activities is a prerequisite and important way to maximize the utility of resources and achieve continuous growth and development of enterprises. Whether entrepreneurship can influence firm growth performance through dual innovation, and the magnitude of the effect of the two innovation strategies, exploratory and utilization innovation, on the path of firm growth impact, need to be further verified.

In addition, in the era of digital economy with the rapid emergence of big data, artificial intelligence and other technologies (Wang et al., 2017[16]), the acquisition, utilization and feedback of information, knowledge and other resources are largely affected by the digitization level of enterprises (Yin et al., 2019[17]). Digitization level, as an important symbol of enterprise digital

transformation, can trigger a profound change in the way of resource allocation through the omni-directional penetration of digital technology in enterprise operation and management (Chen et al., 2021[18]), which breaks the internal environment and the original mode of enterprises to carry out innovative activities and achieve growth and development. At present, existing research has not yet given a clear answer to the questions of whether the digitization level plays an enabling or inhibiting role in the process of entrepreneurship to promote enterprise innovation and growth, and whether it plays different roles for different types of enterprise innovation, which need to be further clarified.

In view of this, this paper takes Technology-Based SMEs as the research object, starts from entrepreneurship, introduces dual innovation as the mediator variable and digitization level as the regulating variable, constructs a model of entrepreneurship's influence mechanism on growth performance, clarifies the effect and path of entrepreneurship's influence on growth performance, explores the influence of entrepreneurship on dual innovation and growth performance under the regulation of digitization level. While enriching the research on entrepreneurship, it also explores the effective paths for enterprises to choose different innovation strategies, maximize the utility of resources, and enhance the growth performance of enterprises under different digitization levels.

2. Theoretical basis and research hypotheses

2.1. Entrepreneurship and Firm Growth Performance

In the digital context, entrepreneurship has evolved into the spiritual system and organizational kernel hidden behind the consciousness and behaviors of organizational members inspired by enterprises in adapting to the ever-changing innovation paradigm (Zhao et al., 2021[19]). The spiritual connotations of innovation, pioneering, and risk-taking possessed by entrepreneurship are fully permeated throughout the company, making entrepreneurship at the enterprise level gradually become a key production factor for the sustainable innovation and development of enterprises (Bai, 2019[20]), and playing an increasingly important role in enhancing the environmental resilience of enterprises and improving their competitiveness. Based on this, this paper formulates the hypothesis:

H1: Entrepreneurship has a significant positive effect on the growth performance of Technology-Based SMEs.

2.2. Dual Innovation and Firm Growth Performance

Dualistic innovation originates from organizational dualistic theory, which was proposed by March (1991[21]) on the basis of his dualistic idea combined with innovation theory, specifically, innovation can be divided into two kinds of innovation behaviors: exploratory and exploitative. Exploratory innovation focuses on realizing technological innovation and upgrading, and is characterized by high risk, long cycle and high innovativeness. In the process of exploring new products, the technical team needs to take the initiative to learn from the outside world and absorb new knowledge, which can promote the growth of employees (Yao & Li, 2021[22]). After the success of exploratory innovation product development, the enterprise can quickly occupy the market, obtain huge monopoly profits, achieve rapid expansion of the organization, and improve the growth performance level of the enterprise (Qi et al., 2020[23]). Exploitative innovation focuses on the reconstruction and optimization of existing resources, which is an intensification of the enterprise's focus on existing areas, and the degree of risk and investment is lower than that of exploratory innovation (Yao & Li, 2021[22]). In the process of exploitative innovation, enterprises firstly enhance their competitiveness by optimizing the existing knowledge base and products of their R&D teams. Secondly, they obtain

short-term performance improvement by improving the production process and optimizing internal operation and management. And finally, they obtain reliable feedback from customers by paying deep attention to customer value, which further promotes optimization and upgrading of products and services, and ultimately enhances the firm growth performance. Based on this, this paper formulates the hypothesis:

H2a: Exploratory innovation has a significant positive effect on the growth performance of Technology-Based SMEs;

H2b: Exploitative innovation has a significant positive effect on the growth performance of Technology-Based SMEs.

2.3. Entrepreneurship and Dual Innovation

The key driver of technological innovation is the entrepreneur, and the most fundamental quality of entrepreneurship is that it drives innovation (Schumpeter, 2004[24]). Entrepreneurship is essentially an act of innovation that gives existing resources new wealth-creating capabilities (Drucker, 1985[25]). Exploratory innovation and exploitative innovation are two different needs for the positioning of enterprise strategy types (Mueller et al., 2013[26]; Dong et al., 2022[27]), which need to give full play to the utility of entrepreneurship strategic choice and resource allocation, to stimulate the enterprise innovation enthusiasm (Chen et al., 2021[28]), so that the enterprise innovation behaviors continue to emerge.

For Technology-Based SMEs, the promotion of corporate dual innovation requires the guidance and incentives of entrepreneurship. On the one hand, entrepreneurship can give full play to the spiritual connotations of pioneering and risk-taking, break through established business models and growth paths (Chen et al., 2021[28]), break through cognitive conflicts and resource bottlenecks in the process of innovation (Zhang et al., 2016[29]), and help enterprise employees to rapidly update the existing knowledge structure, develop new products and new markets, and ultimately realize exploratory innovation. On the other hand, entrepreneurship can motivate enterprises to maximize the rationalization of the allocation of existing resources, continuous improvement and upgrading of products or services, to meet the existing market demand and customer needs to achieve the exploitative innovation (Xu & Li, 2013[30]). Based on this, this paper formulates the hypothesis:

H3a: Entrepreneurship has a significant positive effect on exploratory innovation in Technology-Based SMEs;

H3b: Entrepreneurship has a significant positive effect on exploitative innovation in Technology-Based SMEs.

2.4. The mediating role of Dual Innovation

Based on the analytical framework of resource-based theory “Resource→Strategy→Performance” and the support of relevant empirical studies, this paper further hypothesizes that dual innovation plays a mediating role in entrepreneurship and the growth performance of Technology-Based SMEs. That is, entrepreneurship permeating the firm can enhance the growth performance of Technology-Based SMEs by facilitating the rational allocation of their strategic activities in exploratory and exploitative innovation, and thus enhance the growth performance of the firm. Therefore, this paper proposes the following hypotheses:

H4a: Exploratory innovation mediates the relationship between entrepreneurship and the growth performance of Technology-Based SMEs;

H4b: Exploitative innovation mediates the relationship between entrepreneurship and the growth

performance of Technology-Based SMEs.

2.5. The moderating role of Digitization Level

Digitization level reflects the readiness of the enterprise's digital technology, the intensity of digitization, and the security of the digital platform, and measures the enterprise's resilience to broadly connect internal and external resources as well as to cope with continuous digital change, which has gradually become the key to influencing the output of the enterprise's innovation and performance (Xiao et al., 2021[31]). Based on the editable, associative and extensible features of digital technology, enterprises with high digitalization levels are more likely than traditional enterprises to build digital knowledge and technology communication platforms within the enterprise, alleviate information mismatch caused by information asymmetry (Chen & Yang, 2021[32]), accelerate the acquisition and accumulation of internal and external knowledge (Xin & Meng, 2021[33]), influence the identification and development of innovation opportunities (Lu, 2017[34]) and promote sustainable business growth. At the same time, digitalization enhances the subjective willingness of organizational members to create value (Zhao et al., 2021[19]), and a high level of digitalization contributes to the full penetration of entrepreneurship at the enterprise level, which further exerts the collective effect of entrepreneurship at the organizational level, improves the enterprise's ability to adapt to the environment, better seizes potential opportunities in the market, realizes sustained bi-dimensional innovation activities, and ultimately contributes to the enterprise's growth performance. Based on this, this paper formulates the hypothesis:

H5a: Digitalization level moderates the relationship between entrepreneurship and exploratory innovation in Technology-Based SMEs;

H5b: Digitalization level moderates the relationship between entrepreneurship and exploitative innovation in Technology-Based SMEs.

Combining the above research hypotheses, this paper constructs a model of the influence mechanism of the company's "Entrepreneurship→Dual Innovation→Firm Growth Performance", as shown in Figure 1.

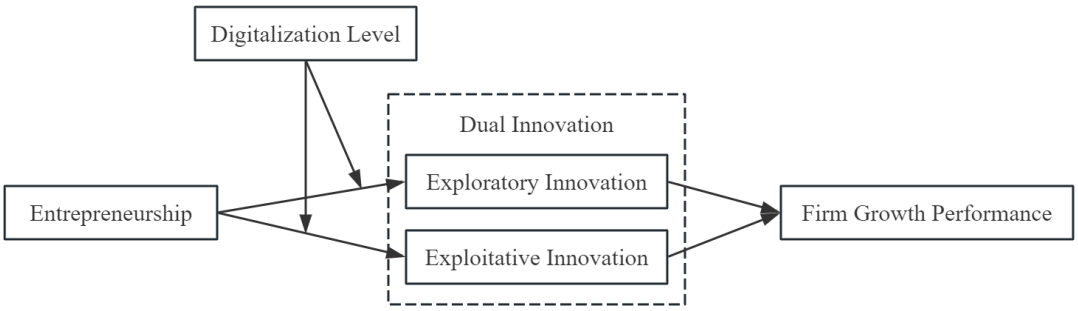

Figure 1: Research model

3. Research design

3.1. Sample and data collection

According to the *Measures for Evaluation of Technology-Based Small and Medium-sized Enterprises* and the *Guiding Opinions on Accelerating Scientific and Technological Innovation for the Development of New Generation of Information Technology and Ten Other Highly Precise*

Industries issued by Beijing, this paper mainly selects Technology-Based SMEs with no more than 500 employees, annual sales revenue and total assets of no more than 200 million yuan, and within the ten highly precise industries which are the focuses of the Beijing Municipality, as the target of the survey, and selects the main founder (chairman, general manager or partner) of the enterprise is selected as the target of data collection. Considering that it takes a certain amount of time for corporate innovation to be reflected in growth performance, the surveyed companies were all founded in 2018 and before. In this paper, 166 valid questionnaires were finally returned, with a valid questionnaire recovery rate of 97.64%, and the sample distribution is shown in Table 1.

Table 1: Distribution of samples

Statistical Category	Index	Quantity	Frequency (%)	Statistical Category	Index	Quantity	Frequency (%)
Nature of Enterprise	Limited Liability Company	82	49.4	Total Number of Employees	1~50	132	79.5
					51~100	23	13.9
	Company Limited by Shares	84	50.6		101~200	9	5.4
					201~500	2	1.2
Year of Establishment	2013	25	15.1	Industry	Machine Manufacturing	24	14.5
	2014	18	10.8		Information Technology	60	36.1
	2015	15	9.0		Biomedical	13	7.8
	2016	46	27.7		New Energy and New Materials	26	15.7
	2017	24	14.5		Software Development	41	24.7
	2018	38	22.9		Else	2	1.2

3.2. Variable measurement

(1) Dependent variable: Entrepreneurship. The measurement scale of entrepreneurship is based on the Covin & Slevin (1989[35]) scale, combined with the research of Covin & Slevin (1991[36]), Zahra (1993[37]), and adapted according to the business environment and business characteristics of Technology-Based SMEs, including three dimensions of innovation, pioneering, and risk-taking, with a total of 9 items.

(2) Mediating variable: Dual Innovation. The dual innovation scale used in this paper is mainly compiled with reference to the scales of Jansen (2006[38]) and Cui et al. (2018[39]), which includes two dimensions of exploitative innovation and exploratory innovation, with a total of 11 items.

(3) Moderating variable: Digitization Level. Quantitative research on enterprise digitization is still in its infancy, and there is not yet a unified scale in the academic world for the measurement of enterprise digitization level. In this paper, based on the research of Wang et al. (2019[40]), a scale for measuring the digitization level is compiled according to the characteristics of Technology-Based SMEs, with a total of 10 items.

(4) Dependent variable: Firm growth performance. Existing studies have not yet formed a unified standard for the measurement of growth performance, and most of them measure the growth performance of entrepreneurial enterprises from objective financial indicators such as sales growth, net income growth, market share growth and asset growth. However, in view of the competitive

environment and short product life cycle of Technology-Based SMEs, their growth performance is not only expressed in the increase of revenues and profits, but also in the improvement of potential future earning capacity (Tian & Zhang, 2021[41]). Meanwhile, since the remaining variables in this study are difficult to be measured by objective indicators, considering data availability and time symmetry of the variables, growth performance is measured by subjective evaluation method. In this paper, we refer to the scales of Tian et al. (2008[42]) and Shen & Wang (2011[43]), which measure the growth performance of enterprises from four aspects: organizational growth, customer satisfaction, employee growth, and employee satisfaction, with a total of five items.

In order to ensure the reliability of the research results, this paper selects the years of the enterprise, the size of the enterprise, the industry to which it belongs and the nature of the enterprise as the control variables. Except for the control variables, the variables in this paper were measured using Likert 5-level scale for measurement.

4. Empirical analysis

4.1. Reliability and validity analysis

The results of the reliability analysis of each variable in this paper are shown in Table 2, the Cronbach's α coefficient of each research variable is more of 0.7, which indicates that each research variable in this paper meets the requirement of reliability. The AVE values of each research variable in this paper are above 0.5, indicating that each research variable has good convergent validity (Fornell & Larcker, 1981[44]). In Table 3 the diagonal line is the square root of the AVE of each variable, and the values are greater than the correlation coefficients between itself and other variables, indicating that each research variable in this paper has good discriminant validity.

Table 2: Reliability and validity tests for variables

Variable	AVE	Cronbach's α
Entrepreneurship	0.582	0.795
Exploitative innovation	0.555	0.769
Exploratory innovation	0.595	0.864
Digitalization level	0.589	0.920
Firm growth performance	0.609	0.839

4.2. Descriptive statistics and correlation analysis

Table 3: Correlation coefficients, differential validity, and descriptive statistics

Variable	Average	Sd.	1	2	3	4	5
1. Entrepreneurship	3.56	0.58	**(0.763)**				
2. Exploratory innovation	4.00	0.69	0.455**	**(0.771)**			
3. Exploitative innovation	3.85	0.65	0.335**	0.743**	**(0.745)**		
4. Digitalization level	3.57	0.70	0.537**	0.496**	0.430**	**(0.767)**	
5. Firm growth performance	3.65	0.64	0.431**	0.498**	0.467**	0.510**	**(0.780)**

Note: ** indicates significant at the 1% level; values in parentheses are AVE square roots

The results of descriptive statistics, as shown in Table 3, show that entrepreneurship is significantly and positively correlated with exploratory innovation (β=0.455, p<0.01), exploitative innovation (β=0.335, p<0.01), and growth performance (β=0.431, p<0.01). Meanwhile, both exploratory innovation and exploitative innovation were significantly positively correlated with growth performance (β=0.498, p<0.01; β=0.467, p<0.01).

4.3. Hypothesis test

(1) Main and mediation effects tests

This paper utilizes hierarchical regression analysis to test the main effect, and the test results are shown in Table 4. According to Model 1 in Table 4, the regression coefficient of entrepreneurship on firm growth performance is positive and significant (β=0.478, p<0.01), which indicates that entrepreneurship has a significant positive effect on firm growth performance and H1 is verified. Meanwhile, Models 2 and 3 in Table 4 show that the regression coefficients of exploratory innovation as well as exploitative innovation are positive and significant (β=0.463, p<0.01; β=0.465, p<0.01), which indicates that there is a significant positive effect of exploratory and utilized innovations on the firm growth performance, H2a and H2b are verified.

For the test of mediation effect, this paper adopts the mediation effect test proposed by Baron & Kenny (1986[45]). As can be seen from Model 6 and Model 7 in Table 4, the standardized regression coefficients of entrepreneurship on exploratory innovation as well as exploitative innovation are 0.535 (p<0.01) and 0.367 (p<0.01), respectively, indicating that there is a significant positive effect of entrepreneurship on exploratory innovation as well as exploitative innovation in Technology-Based SMEs, H3a and H3b are verified. And the promotion effect of entrepreneurship on exploratory innovation is greater than the promotion effect of entrepreneurship on exploitative innovation (0.535 ＞0.367). Combining model 1 and model 4 in Table 4, the regression coefficients of entrepreneurship and exploratory innovation are significant, and the regression coefficient of the independent variable entrepreneurship in model 4 (β=0.288) is smaller than the regression coefficient of model 1 (β=0.478), which indicates that exploratory innovation plays a partially intermediary role in the relationship between entrepreneurship and firm growth performance, and H4a is verified. Similarly, the results of Model 5 indicate that exploitative innovation plays a partially mediating role in the relationship between entrepreneurship and firm growth performance, and H4b is validated.

Table 4: Results of regression analysis of main and mediating effects

Variable	Firm growth performance					Exploratory innovation	Exploitative innovation
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Control variable							
Age	-0.002 (0.036)	0.008 (0.034)	0.010 (0.035)	0.011 (0.033)	0.015 (0.033)	-0.039 (0.037)	-0.048 (0.037)
Scale	-0.015 (0.085)	0.029 (0.081)	0.022 (0.082)	0.002 (0.079)	-0.009 (0.078)	-0.048 (0.089)	-0.016 (0.089)
Industry	0.009 (0.033)	-0.007 (0.032)	-0.011 (0.032)	0.008 (0.031)	0.009 (0.031)	0.003 (0.035)	-0.001 (0.035)
Nature	-0.051 (0.137)	-0.064 (0.132)	-0.139 (0.134)	-0.048 (0.128)	-0.102 (0.128)	-0.007 (0.145)	0.142 (0.144)
Independent variable							

Entrepreneurship	0.478*** (0.080)			0.288*** (0.083)	0.344*** (0.078)	0.535*** (0.084)	0.367*** (0.084)
Mediating variable							
Exploratory innovation		0.463*** (0.065)		0.354*** (0.070)			
Exploitative innovation			0.465*** (0.070)		0.365*** (0.070)		
Regression indicator							
Adj. R^2	0.164	0.226	0.200	0.276	0.282	0.197	0.094
F	7.463***	10.637***	9.263***	11.463***	11.798***	9.088***	4.431***

Note: *, **, *** respectively indicate significant at the 10%, 5%, and 1% levels; values in parentheses are standard errors, same below.

In order to further verify whether the mediating effect exists, this paper uses the Bootstrap method of the PROCESS program to test the mediating effect again, and the test results are shown in Table 5. The indirect effect values of exploratory innovation and exploitative innovation are 0.1916 and 0.1345 respectively, and the corresponding 95% confidence intervals do not contain 0, indicating that the mediating effect of exploratory innovation and exploitative innovation is significant, and H4a and H4b are verified again.

Table 5: Bootstrap test results for mediating effects

Path relationship	Effect type	Effect size	Sd.	95% confidence interval	
				Upper limit	Lower limit
Entrepreneurship→Exploratory Innovation→Growth Performance	Total effect	0.4757	0.0779	0.3220	0.6295
	Direct effect	0.2841	0.0813	0.1236	0.4446
	Indirect effect	0.1916	0.0704	0.0785	0.3503
Entrepreneurship→Exploitative Innovation→Growth Performance	Total effect	0.4757	0.0779	0.3220	0.6295
	Direct effect	0.3413	0.0767	0.1898	0.4927
	Indirect effect	0.1345	0.0480	0.0551	0.2416

Table 6: Moderating effect test results for digitization level

Variable	Exploratory innovation			Exploitative innovation		
	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
Control variable						
Age	-0.025 (0.036)	-0.023 (0.035)	-0.022 (0.034)	-0.035 (0.036)	-0.034 (0.035)	-0.034 (0.035)
Scale	-0.033 (0.084)	-0.050 (0.083)	-0.063 (0.081)	-0.002 (0.085)	-0.018 (0.084)	-0.026 (0.084)
Industry	-0.004 (0.033)	-0.001 (0.033)	0.010 (0.032)	-0.006 (0.033)	-0.004 (0.033)	0.003 (0.033)
Nature	-0.038 (0.137)	-0.004 (0.135)	0.035 (0.134)	0.112 (0.138)	0.145 (0.136)	0.174 (0.137)

Independent variable						
Entrepreneurship	0.314*** (0.094)	0.341*** (0.093)	0.248** (0.098)	0.159* (0.095)	0.184* (0.094)	0.142 (0.100)
Moderator variable						
Digitization level	0.342*** (0.078)	0.281*** (0.080)	0.230*** (0.087)	0.321*** (0.078)	0.264*** (0.080)	0.250*** (0.089)
Digitization level^2			0.238** (0.107)			0.164 (0.110)
Interaction term						
Entrepreneurship* Digitization level		-0.336*** (0.128)	-0.362** (0.176)		-0.320** (0.128)	-0.390** (0.181)
Entrepreneurship* Digitization level^2			0.332*** (0.121)			0.158 (0.125)
Regression indicator						
Adj. R^2	0.279	0.305	0.336	0.176	0.202	0.207
F	11. 627***	11.325***	10.271***	6.869***	6.969***	5.777***

(2) Moderating effect test

This paper uses digitization level as a moderating variable to explore the effect of entrepreneurship on dual innovation under different levels of digitization. In order to reduce the impact of multicollinearity on the results of the regression analysis, this paper adopts the suggestion of Robinson & Schumacker (2009[46]) and centers all variables involved in the interaction term before testing the moderating effect.

The results of the moderating effect test are shown in Table 6, which shows that the digitalization level negatively moderates the relationship between entrepreneurship and exploratory innovation, and exploitative innovation, but it does not mean that the increase in the digitalization level necessarily hampers the promotion of entrepreneurship on exploratory and exploitative innovation in Technology-Based SMEs. As can be seen from Model 10 in Table 6, the interaction between entrepreneurship and the quadratic term of digitization level positively affects exploratory innovation, indicating that there is a U-shaped moderating effect of digitization level between entrepreneurship and exploratory innovation, i.e., with the increase of digitization level, the effect of entrepreneurship on exploratory innovation tends to decrease first and then increase (see Figure 2). However, it is worth noting that the digitization level does not have a U-shaped moderating effect between entrepreneurship and exploitative innovation, but only a negative moderating effect (see Model 13 in Table 6, Figure 3). The above results indicate that H5a and H5b are validated, respectively.

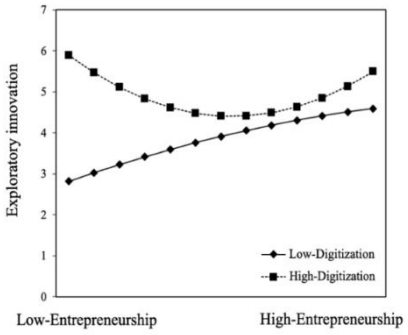

Figure 2: Moderating effect of digitization level on entrepreneurship and exploratory innovation

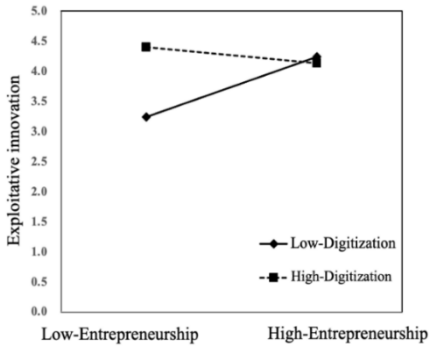

Figure 3: Moderating effect of digitization level on entrepreneurship and exploitative innovation

5. Conclusion and discussion

First, entrepreneurship has a significant role in enhancing the growth performance of Technology-Based SMEs. Entrepreneurship, as a kind of behavioral orientation at the enterprise level, plays an important role in the innovative growth of enterprises mainly through the innovative, pioneering and risk-taking spirit of SMEs, which is consistent with the findings of most scholars (Zhu, 2020[47]). Higher entrepreneurial spirit makes enterprises dare to be the first in the complex and changing market competition, more innovative and pioneering, so as to actively grasp the key development time, break through the growth bottleneck, form and constantly optimize their core competitiveness, and continuously improve firm growth performance.

Second, dual innovation plays a mediating role between entrepreneurship and Technology-Based SMEs' growth performance, i.e., entrepreneurship positively affects Technology-Based SMEs' growth performance through exploratory innovation and exploitative innovation respectively. Meanwhile, dual innovation plays a differentiated role in the process from entrepreneurship to growth performance, and Technology-Based SMEs more often realize the effective path from entrepreneurship to growth performance by implementing exploratory innovation.

Third, there is a moderating effect of digitization level in the relationship between entrepreneurship and dual innovation in Technology-Based SMEs. With the increase of enterprise digitalization level, the effect of entrepreneurship on exploratory innovation shows a tendency of decreasing and then increasing, while the digitalization level shows a negative regulation in the relationship between entrepreneurship and exploitative innovation. In the early stage of digitization construction of Technology-Based SMEs, the related investment in hard and software environment makes the internal environment of enterprise innovation and growth change, but the role of digitization construction in empowering enterprise innovation and growth has not yet been brought into full play, and on the contrary, it has weakened the existing path to achieve dual innovation and enterprise growth through the use of entrepreneurship due to the problem of resource allocation. At the same time, the early stage of the introduction of digital technology is often accompanied by risks and uncertainties, and risk issues such as data security also impede the effectiveness of exploratory and utilization innovation activities by Technology-Based SMEs using entrepreneurship. With the further completion of digital infrastructure construction, the risk control ability of enterprise digital technology is gradually improved, and enterprises can accurately identify the possible paths of technological evolution while acquiring more valuable information resources in the digital model and environment, helping them make scientific innovation decisions (Tang, 2020[48]).

6. Research shortcomings and outlook

This paper explores the mechanism of entrepreneurship on growth performance based on cross-sectional survey data, and it is difficult to reflect the dynamic process of entrepreneurship's impact on dual innovation and growth performance. Future research can take into account both cross-sectional and longitudinal studies through continuous tracking surveys to explore in-depth the impact of entrepreneurship on growth performance, and to enhance the scientificity and comprehensiveness of the study. Moreover, the research object can be expanded from Technology-Based SMEs to other enterprise types to further validate the research conclusions of this paper and form a general law with more fundamental value. At the same time, future research can further explore other role paths and boundary conditions according to the enterprise digitalization construction and its environmental changes, so as to be more in line with the real situation and management practice of enterprises.

References

[1] Yan Huang, Qiuyan Tao, Fulin Zhu. Relationship Intensity, Knowledge Transfer and Innovation Performance of Technology-based SMEs[J]. Enterprise Economy, 2017, 36(12): 88-94.

[2] Haigang Wang, Gang Chen, Xu Cheng. The Risk Analyses and Countermeasures of Technology Innovation for High Tech Small and Mid-Sized Enterprises[J]. Journal of Shaanxi University of Science & Technology, 2012, 30(06):151-154.

[3] Penrose E T. The Theory of the Growth of the Firm [M]. Oxford university press, USA, 2009.

[4] Adner R, Helfat C E. Corporate effects and dynamic managerial capabilities[J]. Strategic management journal, 2003, 24(10): 1011-1025.

[5] Jin Chen, Ruixu Wang. A Review of Research on Top Management Teams[J]. China Management Informationization, 2010, 13(01): 78-81.

[6] Ping Nie, Ting Luo. Research on the Correction of Internal Control on the Relationship between Entrepreneurship and Enterprise Strategy[J]. Communication of Finance and Accounting, 2019(33): 87-95.

[7] Huaiying Zhang, Lu Li, Hui Jiang. Research on SMEs Performance Impact Mechanism from the Perspective of Relationship and Capability [J]. Chinese Journal of Management, 2021, 18(3): 353-361.

[8] Fengxia Liu. Entrepreneurship, Innovation Incentive and Enterprise Innovation Performance[J]. Communication of Finance and Accounting, 2019, 40(36): 55-58.

[9] Ruoyi Xi, Anqi Li, Exiu Zhang. Exploring the Influence Mechanism of Entrepreneurship on the Performance of Small and Medium-Sized Enterprises [J]. Modern Business, 2019, 19(02): 108-111.

[10] Guisheng Sun, Shaoqing Tang, Jianyuan Tao, Jiaming Yan. Internal logic analysis of entrepreneurship, innovation culture and high-quality development [J]. China Soft Science, 2024, (S1): 454-461.

[11] Junqiang Shen. The Relationship Between Network Embeddedness and Growth Performance of Logistics Enterprises—Based on the Mediation Effect of Absorptive Capacity [J]. Journal of Commercial Economics, 2021(22): 113-116.

[12] Weidong Guo, Junxia Hou. Impact of Key Resource Acquisition on the Growth Performance of New Venture Under the Background of Mass Entrepreneurship and Innovation Mediation Effects Based on Dynamic Capabilities[J]. Journal of Capital University of Economics and Business, 2021, 23(03): 86-100.

[13] Xia Gao, Linxing Lei, Fenfen Ma. Digital Finance, Financing Constraints and Business Growth[J]. Communication of Finance and Accounting, 2022(02): 68-71.

[14] Sha Lan, Haiqing Hu. Impact of Dual Innovation Dynamic Equilibrium on Sustainable Competitive Advantages of Enterprises [J]. Statistics & Decision, 2024, 40(05): 166-171.

[15] Wang C L, Rafiq M. Ambidextrous Organizational Culture, Contextual Ambidexterity and New Product Innovation: A Comparative Study of UK and Chinese High-tech Firms [J]. British Journal of Management, 2014, 25(1): 58-76.

[16] Wang Y, Lee J, Fang E, Ma S. Project customization and the supplier revenue–cost dilemmas: The critical roles of supplier–customer coordination[J]. Journal of Marketing, 2017, 81(1): 136-154.

[17] Yin Z, Gong X, Guo P, Wu T. What drives entrepreneurship in digital economy? Evidence from China[J]. Economic Modelling, 2019, 82: 66-73.

[18] Qingjiang Chen, Maofeng Wan, Yanmeng Wang. The Influence of Digital Technology Application on Ambidextrous Innovation of Enterprises—Empirical Test Based on Organizational Life Cycle[J]. Soft Science, 2021, 35(11): 92-98.

[19] Donghui Zhao, Xinbo Sun, Yu Qian, Dapeng Zhang. The Emergence of Organization Entrepreneurship in the Digital Age: Grounded Theory Analysis Based on Multiple Cases[J]. Human Resources Development of China, 2021, 38(07): 92-108.
[20] Changhong Bai. The Evolution of Entrepreneurship[J]. Nankai Business Review, 2019, 22(05):2+1.
[21] March J G. Exploration and exploitation in organizational learning[J]. Organization Science, 1991, 2(02): 71-87.
[22] Kai Yao, Xiaolin Li. The Interaction Effect Between Organizational Ambidexterity and Entrepreneurial Bricolage—A Case Study Based on Pet Food Industry[J]. Journal of Fudan University (Natural Science), 2021, 60(01): 1-13.
[23] Xiuhui Qi, Yifeng Wang, Zhengling Sun. Dual Innovation, Entrepreneur's Risk-Taking Tendency and Enterprise Performance[J]. Science & Technology Progress and Policy, 2020, 37(16): 104-110.
[24] Schumpeter J A. The Theory of Economic Development[M]. Boston: Harvard University Press, 2004.
[25] Drucker P F. Innovation and Entrepreneurship: Practice and Principles[J]. Social Science Electronic Publishing, 1985, 4(1):85-86.
[26] Mueller V, Rosenbusch N, Bausch A. Success patterns of exploratory and exploitative innovation: A meta-analysis of the influence of institutional factors[J]. Journal of Management, 2013, 39(6): 1606-1636.
[27] Baobao Dong, Songsong Cheng, Lan Zhang. Ambidexterity Innovation: Review and Future Research Agenda[J]. Chinese Journal of Management, 2022, 19(02): 308-316.
[28] Hongmei Chen, Min Liang, Penghua Qiao. Entrepreneurship, R&D Investment and Regional Innovation Performance[J]. The World of Survey and Research, 2021(03): 58-64.
[29] Min Zhang, Yili Zhang, Peipei Fan. The Game Between "I" Self-Cognition and "Me" Self-cognition of Entrepreneurs: A New Cognitive Perspective of Ambidextrous Innovation Path[J]. Foreign Economics & Management, 2016, 38(02): 3-15.
[30] Hui Xu, Wen Li. Empirical Study on Relationship Between Organizational Learning and Ambidextrous Innovation in High-Tech Enterprises[J]. Journal of Management Science, 2013, 26(04): 35-45.
[31] Renqiao Xiao, Jiajia Shen, Li Qian. The Influence of Digitalization Level on the Performance Of New Product Development: Based on the Mediating Role of Ambidextrous Innovation Capability[J]. Science & Technology Progress and Policy, 2021, 38(24): 106-115.
[32] Xiaodong Chen, Xiaoxia Yang. The Impact of Digital Economic Development on the Upgrading of Industrial Structure: Based on the Research of Grey Relational Entropy and Dissipative Structure Theory[J]. Reform, 2021,(03):26-39.
[33] Lin Xin, Xintong Meng. A Study on the Influence of Network Effects on the Innovation Performance of Digital Economy Enterprises[J]. Friends of Accounting, 2021(24): 57-64.
[34] Xifeng Lu. A Study on the Impact of Opportunity Innovativeness and Knowledge Acquisition on Firm Performance—A Case Study of Science and Technology-Based Firms[J]. Information Science, 2017, 35(05): 160-164.
[35] Covin J G, Slevin D P. Strategic Management of Small Firms in Hostile and Benign Environments[J]. Strategic Management, 1989, 10:75-87.
[36] Covin J G, Slevin D P. A Conceptual Model of Entrepreneurship As Firm Behaviour[J]. Entrepreneurship Theory and Practice, 1991, 16(1): 7-25.
[37] Zahra S A. A Conceptual Model of Entrepreneurship As Firm Behaviour: A Critique and Extension[J]. Entrepreneurship Theory and Practice, 1993, 17(4): 5-21.
[38] Jansen J J, Van Den Bosch F A J, Volberda H W. Exploratory Innovation, Exploitative Innovation, and Performance: Effects of Organizational Antecedents Environment Moderators[J]. Management Science, 2006, 52(11): 1661-1674.
[39] Yuehui Cui, Baoshan Ge, Baobao Dong. Ambidextrous Innovation and New Venture Performance: A Combined Moderating Effect Model Based on the Multilevel Network Structure[J]. Foreign Economics & Management, 2018, 40(8): 45-57.
[40] Rui Wang, Ming Dong, Wenhao Hou. Research on Digital Maturity Evaluation Model and Method for Manufacturing Enterprises[J]. Science and Technology Management Research, 2019, 39(19): 57-64.
[41] Lin Tian, Lulu Zhang. Establishment of Growth Evaluation System for Technology Based SMEs Based on Fuzzy ANP and TOPSIS[J]. Operations Research and Management Science, 2021, 30(02):184-190.
[42] Xiaoming Tian, Qinfeng Jiang, Zhongming Wang. The Empirical Analysis of Relationship Between Enterprises' Dynamic Capabilities and Entrepreneurial Performance[J]. Studies in Science of Science, 2008(04): 812-819.
[43] Chaohong Shen, Chongming Wang. The Exploration on the Entrepreneurship Performance Structure and the Explanation Based on Contract[J]. Nanjing Journal of Social Sciences, 2011(01): 36-42.
[44] Fornell C, Larcker D F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error[J]. Journal of Marketing Research, 1981, 24(02): 337-346.
[45] Baron R M, Kenny D A. The Moderator-Mediator Variable Distinction in Social Psychological Research:

Conceptual, Strategic, and Statistical Considerations [J]. Journal of Personality and Social Psychology, 1986, 51(06): 1173-1182.
[46] Robinson C, Schumacker R E. Interaction Effects: Centering, Variance Inflation Factor, and Interpretation Issues[J]. Multiple Linear Regression Viewpoints, 2009, 35(01): 6-11.
[47] Lu Zhu. The Effect of Entrepreneurial Innovativeness on Firm Growth Performance in A Dynamic Environment[D]. Yunnan University, 2019.
[48] Song Tang, Xuchuan Wu, Jia Zhu. Digital Finance and Enterprise Technology Innovation: Structural Feature, Mechanism Identification and Effect Difference Under Financial Supervision[J]. Journal of Management World, 2020, 36(05): 52-66+9.