Analysis of the Influence Path and Utility of Enterprise Fission Strategy on SMEs

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Abstract. The "fission" strategy, characterized by its holistic nature, presents a novel approach to organizational change that promotes innovation and strengthens industrial chains. This paper analyzes Chinese SMEs(producing new and unique products using special and sophisticated technologies), using an antecedent-process-outcome framework and a two-way fixed-effects model to assess the impact of the fission strategy. The findings reveal that the fission strategy significantly boosts the overall innovation capacity of SMEs, with varying effects across different types of innovation. Younger firms are more likely to unlock their innovation potential during the fission process, while high-risk enterprises often adopt fission to mitigate market uncertainty. The paper also offers recommendations on government policy, strategic planning, and financial support, providing valuable insights for SME development.

Keywords: fission strategy, SMEs, innovation capability

1 Introduction

Economic globalization and digitalization have heightened attention on the quality and innovation capacity of small and medium-sized enterprises (SMEs). During their startup phase, SMEs often struggle to focus on market segments and enhance technological capabilities [1]. Fission-derived enterprises can leverage essential resources from the parent company, such as technology, capital, and market access, which boosts their survivability despite limited resources [2]. This process also generates a positive feedback loop, benefiting the parent enterprise. For SMEs, the fission strategy effectively addresses capital and market resource shortages during the startup phase. It supports rapid development and helps avoid technical or market expansion challenges caused by resource constraints [3]. While the fission strategy has been widely studied in large enterprises, its findings do not directly apply to SMEs due to differences in resource base, innovation motivation, and organizational structure. SMEs face more severe resource limitations and market uncertainties.

This paper adopts the 'antecedents-process-results' framework and uses a two-way fixed-effects model to analyze the impact of the fission strategy on corporate innovation, exploring its role in enhancing innovation capabilities. The study highlights how

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the fission strategy promotes innovation through optimal resource allocation and knowledge spillovers, offering new insights and theoretical support for existing research on this strategy. It also proposes innovation pathways based on the fission strategy for SMEs, providing valuable guidance for policymakers and enterprise managers on resource integration and innovation capacity enhancement.

2 'Antecedent-Process-Outcome' Theoretical Framework and Basic Assumptions

2.1 Antecedents: The Triggering Mechanism of the Fission Strategy

The implementation of the fission strategy is influenced by both the internal resource endowment of the parent company and changes in the external environment. When the parent company has abundant internal resources, a resource overflow may occur [4]. In such cases, the parent firm will proactively support internal innovation projects, leverage external opportunities, and use incentives to foster a new enterprise. [5] This process helps the parent break free from established practices, promoting open innovation [6], which drives innovation and entrepreneurial growth at both ends of the spectrum. When external policies and market opportunities are favorable, the parent firm tends to support the independent innovation of spin-offs, acting as a "platform" and actively reallocating resources to promote a sharing effect [7].

2.2 Process: The Implementation Mechanism of the Fission Strategy

The fission strategy optimizes resource allocation and enhances innovation capabilities by fostering value co-creation between the parent company and spin-offs [8]. The parent company transfers surplus yet valuable technologies to the spin-off, which independently refines and applies them in the market. Moreover, spin-off SMEs can quickly test new technologies using the parent company's established market channels and customer networks, creating a "market-technology" adaptation mechanism that boosts innovation efficiency [9]. This allows SMEs to fill gaps in the industrial chain or engage in differentiated competition, enabling rapid entry into new markets and increasing market share.

2.3 Results and Basic Assumptions

(1) Knowledge Spillover: The innovation effect of the fission strategy primarily results from a two-way knowledge spillover between the parent and spin-off enterprises. This mechanism promotes optimal resource allocation and enhances innovation capacity through synergy. The parent company releases surplus resources via fission, reduces organizational inertia, and refines its technological path by reintegrating knowledge and incorporating external feedback, such as market demand data. For instance, when Haier spun off Raytheon Technology, iterative feedback on heat dissipation technology for gaming laptops led to breakthroughs in heat dissipation modules for smart home

appliances. Meanwhile, the spin-off companies quickly absorbed this knowledge, transforming it into innovative outputs due to their close connection with the parent company [10].

H1: The fission strategy enhances the innovation capabilities of both the parent and spin-off enterprises through bidirectional knowledge spillover.

(2) Knowledge Filtering: The knowledge filtering mechanism enables the spin-off enterprise to extract non-core knowledge from the parent, allowing the parent company to focus on its core business [11]. Meanwhile, spin-off enterprises utilize filtered knowledge, such as technology modules with high market applicability, to rapidly convert it into practical innovations. In line with the exploration - exploitation theory [12], the parent company's innovations are usually exploratory in nature. These are based on technological accumulation and experimentation. In contrast, spin - off innovations are more exploitative, centering on practical experience and market feedback. Together, these innovations create a complementary, sustainable ecosystem that enhances the competitiveness of the industrial chain [13].

H2: The fission strategy fosters differentiated synergistic innovation effects between the parent and spin-off firms through the knowledge filtering mechanism.

3 Research Design

3.1 Data Source and Sample Description

This study focuses on state-recognized SMEs from 2015 to 2021. The data for relevant variables is sourced from the CSMAR database, CNRDS database, and other public sources, including data referenced in the study by Wu [14].

3.2 Model Design and Variable Description

To assess the impact of the fission strategy on SME innovation, this paper constructs a two-way fixed-effects model. This model controls for both year and firm fixed effects, thereby mitigating the influence of unobserved heterogeneity on the results. Additionally, to address potential endogeneity, control variables are included to further refine the analysis.

$$Patent_{i,t} = \alpha_0 + \alpha_1 Branch + \alpha_n Controls_{i,t} + \sum Year + \sum Firm + \varepsilon_{i,t} \tag{1}$$

Where i denotes the firm and t denotes the year, Patent serves as a proxy for the firm's innovation level. It includes the overall innovation level (*Patent*), substantive innovation level (*Patent_Sub*), and strategic innovation level (*Patent_Str*), measured by the logarithm of the number of patent applications plus one. This is calculated for the firm as a whole, for invention patents, utility models, and designs, respectively [15]. The *Branch* is a proxy for the enterprise's fission strategy, measured by the logarithmic transformation of the number of branches established by SMEs in a given year. Controls refer to a set of control variables that capture the operational and developmental characteristics of SMEs. These include administrative penalties (*Penalty*), foreign investment (*Investment*), business changes (*Change*), and import/export activities (*Im-export*), with residual terms incorporated. Additionally, the model controls for firm (*Firm*) and year (*Year*) fixed effects, adjusts for clustering at the firm level, and uses robust standard errors.

4 Empirical Analyses

4.1 Benchmark Regression – Two-Way Fixed Effects Model

Table 1 presents the results of the benchmark regression analysis, which incorporates control variables, firm fixed effects, and year fixed effects sequentially. The regression coefficients for Branch in Columns (1) to (3) are all significantly positive at the 1% level, indicating that the fission strategy of SMEs positively impacts their innovation capacity, and this effect is robust. For further analysis, the study distinguishes between 'innovation' types, testing 'substantive innovation' and 'strategic innovation' separately. The regression coefficients for Branch in Columns (4) and (5) are 0.022 and 0.052, respectively, with significance at the 10% and 1% levels. These results suggest that corporate fission promotes different types of innovation, with a stronger facilitating effect on strategic innovation compared to substantive innovation.

Table 1. Benchmark Regression Analysis Results.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Patent	Patent	Patent	Patent	Patent_Sub	Patent_Str
Branch	0.155^{***}	0.076^{***}	0.083^{***}	0.066^{***}	0.022^{*}	0.052^{***}
	(0.021)	(0.020)	(0.017)	(0.016)	(0.012)	(0.015)
Controls	No	Yes	Yes	Yes	Yes	Yes
Company FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes
Observations	253685	253685	253685	253685	253685	253685
R-squared	0.0003	0.0058	0.4202	0.4663	0.4838	0.4333

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.2 Endogeneity Test

1. Lagging Explanatory Variables: To account for the potential delayed effect of the fission strategy on firm innovation and avoid reverse causality, this paper lags the fission strategy by one period *(L. Branch)* in the regression analysis. The regression coefficient for L. Branch in Column (1) of Table 2 is significantly positive, indicating that the results remain robust even after considering the two-way causality effects.

2. Instrumental Variables Test: This paper uses the scale of off-site government procurement orders obtained by SMEs as an instrumental variable. Off-site government procurement influences the decision to implement fission, such as whether to establish operations in off-site locations. However, since it is a government decision, it does not directly affect enterprise innovation, making it a valid instrumental variable.

The corresponding regression coefficients in Columns (2) and (3) of Table 2 are significant, further confirming the validity of the model.

3. Heckman Two-Stage Selection Model: To address potential estimation bias from sample selection, this paper uses the Heckman two-stage selection model for endogeneity testing. The results from the second stage show that the IMR term is not significant, indicating that sample selection bias does not affect the model.

Table 2. Results of Endogeneity Test Analysis.

Variable	(1)	(2)	(3)	(4)
	Patent	Branch	Patent	Patent
L. Branch	0.050***			
	(0.017)			
Branch			1.686*	0.066***
			(0.924)	(0.016)
Eproc		0.003***		
		(0.001)		
IMR				-0.695
				(0.672)
Controls	Yes	Yes	Yes	Yes
Company FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	214023	253685	253685	253685
R-squared	0.484	0.310	-0.030	0.466
Wald F statistic			128.57	

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.3 Robustness Tests

1. Using the inverse hyperbolic sine transformation to create the variable Patent_IHS [14], which better captures non-linear relationships and right-skewed data. This reduces bias from extreme values while preserving scale. The results in Column (1) of Table 3 remain significantly positive, confirming the result robustness.

2. Given its high number of zeros and discrete nature, we apply a zero-inflated negative binomial regression. Results in Column (2) of Table 3 are statistically significant, validating robustness.

3. The baseline model also controls for industry-year and city-year fixed effects. Results in Column (3) of Table 3 remain significantly positive, reinforcing the validity of the conclusions.

Table 3. Robustness test analysis results.

Variable	Replacement of Explanatory Variables	Zero-Inflated Negative Binomial Model	Interaction Fixed Effects
	(1)	(2)	(3)
	Patent_IHS	Patent_num	Patent
Branch	0.081***	0.074***	0.068***
	(0.020)	(0.028)	(0.016)

Controls	Yes	Yes	Yes
Company FE	Yes	No	Yes
Year FE	Yes	Yes	Yes
Industry * Year FE	No	No	Yes
City * Year FE	No	No	Yes
Observations	253685	253685	253685
R-squared	0.465	(log likelihood: -503132.8)	0.480

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

5 Heterogeneity Analysis

5.1 Analysis of the Impact of the Years of Establishment of Enterprises

The fission strategy is more likely to be adopted by parent companies with abundant resources, innovation bottlenecks, and a favorable external environment. Spin-offs create value by synergizing with the parent, inheriting and transferring resources. The parent company's age affects its resource accumulation and innovation, influencing the fission strategy. Similarly, a spin-off's age impacts its connection with the parent, affecting innovation development. This paper introduces the interaction term between the parent's age and expansion level to explore fission's impact on SME innovation capabilities.

The regression coefficients in Column (2) of Table 4 are significantly negative at the 10% level, while those in Columns (1) and (3) are not significant. This indicates that the effect of fission on innovation varies by firm age. Older firms have a weaker innovation - enhancing effect because of rigid innovation models and organizational inertia. For strategic and overall innovation, age doesn't significantly moderate the effect, indicating that resource allocation and strategic adjustments, not age, are key innovation drivers.

Table 4. Analysis of the Impact of the Number of Years of Establishment.

Variable	(1)	(2)	(3)
	Patent	Patent_Sub	Patent_Str
Age	0.442***	0.203***	0.339***
	(0.013)	(0.010)	(0.011)
Branch	0.155**	0.102**	0.067
	(0.066)	(0.048)	(0.061)
Branch*Age	-0.042	-0.035*	-0.010
	(0.027)	(0.019)	(0.025)
Controls	Yes	Yes	Yes
Company FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	253685	253685	253685
R-squared	0.469	0.485	0.435

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

5.2 Analysis of the Impact of the Risk Level of Business Violations

The fission development strategy enables parent companies to nurture SMEs by creating significant impact through small actions. These enterprises integrate internal and external resources to improve risk management, reducing the likelihood of business violations. To explore fission's impact on innovation, this paper introduces the variable *Creditrisk*, which measures the annual frequency of an enterprise being classified as a defaulter or executor, using a logarithmic transformation.

The regression coefficients in Column (1) of Table 5 for overall innovation and Column (3) for strategic innovation are significantly positive, while the coefficient for substantive innovation in Column (2) is insignificant. This indicates that higher operational violation risks drive stronger overall and strategic innovation through fission. Firms facing these risks may focus on technological innovation to overcome challenges. However, substantive innovation is less influenced by operational risks and depends more on long-term accumulation and strategic decisions.

Table 5. Analysis of the Impact of the Risk Level of Business Violations in Firms.

Variable	(1)	(2)	(3)
	Patent	Patent_Sub	Patent_Str
Creditrisk	-0.001	-0.002***	0.001
	(0.002)	(0.001)	(0.002)
Branch	0.065***	0.022*	0.052***
	(0.016)	(0.012)	(0.015)
Branch*Creditrisk	0.043***	-0.001	0.042***
	(0.003)	(0.001)	(0.003)
Controls	Yes	Yes	Yes
Company FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	253685	253685	253685
R-squared	0.466	0.484	0.433

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

6 Conclusions

This paper analyzes the impact of the fission strategy on the innovation capacity of SMEs through a theoretical 'antecedents-process-results' framework, combined with empirical tests using a two-way fixed-effects model. The study finds that the fission strategy enhances innovation through knowledge spillover and knowledge filtering mechanisms, significantly improving the innovation capabilities of SMEs, with a more pronounced effect on strategic innovations.

While the paper provides valuable insights, there are some limitations. The success of fission enterprises may also be influenced by factors such as corporate culture and management practices. Future research could incorporate additional enterprise-level variables to enhance the theoretical framework of fission strategies.

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