

Investigating the Influencing Factors of Technological Innovation and Sustainability of SMEs in China

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Abstract

Small and Medium Enterprises (SMEs) serve as vital engines of economic growth, particularly in technology-intensive industries. This study explores the key factors influencing technological innovation and sustainability among SMEs in China. By examining industrial distribution, technological classification, growth stages, workforce composition, and business longevity, this research provides a comprehensive understanding of the challenges and opportunities shaping SME development. The findings reveal that a substantial proportion of SMEs operate within the electronics sector (51.4%), followed by advanced technology manufacturing (25.7%). Furthermore, the majority of SMEs fall within the city-level technological classification (61.5%) and are in the rapid-growth stage (30.3%). Workforce size is identified as a crucial determinant of sustainability, with 35.8% of SMEs employing fewer than 100 workers. These insights underscore the necessity for targeted policy interventions to promote technological adoption, workforce upskilling, and financial stability, thereby enhancing SME competitiveness and ensuring long-term sustainability. This study contributes to the ongoing discourse on SME development in China by offering empirical insights and strategic recommendations to strengthen innovation capacity and sustainable growth.

Keywords: SMEs, Technological Innovation, Sustainability, China, Workforce Composition, Policy Intervention, Economic Growth

Introduction

Small and Medium Enterprises (SMEs) are fundamental to China's economic transformation, serving as key drivers of employment generation, technological progress, and industrial diversification (Liu et al., 2021). As the backbone of the Chinese economy, SMEs contribute over 60% of the country's GDP and account for approximately 80% of urban employment (Zhou & Li, 2020). Their role in fostering innovation and enhancing market competitiveness has been widely acknowledged, particularly in technology-intensive sectors. In recognition of

their significance, the Chinese government has implemented strategic policies, including *Made in China 2025*, aimed at enhancing SME innovation capabilities, promoting industrial upgrading, and ensuring long-term sustainability (Chen et al., 2022). Despite these policy initiatives, SMEs continue to face persistent challenges, including limited access to financial resources, regulatory complexities, and difficulties in sustaining technological advancements (Huang & Zhang, 2021).

Empirical studies suggest that although SMEs play a crucial role in driving economic dynamism and innovation, their survival rates remain low due to financial constraints, market competition, and the slow adoption of emerging technologies (Acs et al., 2019). Many SMEs struggle with securing the necessary investment to support research and development (R&D), which hinders their capacity to innovate and adapt to evolving market demands (Gao & Zang, 2021). Moreover, the rapid pace of technological change has heightened competitive pressures, particularly for SMEs in high-tech industries, making it increasingly difficult for them to achieve sustainable growth (Wang & Liu, 2020). Given these challenges, there is a pressing need to investigate the key determinants influencing SME technological innovation and sustainability in the Chinese context.

This study seeks to bridge this gap by examining the factors that affect SME innovation performance and long-term viability. It explores the distribution of SMEs across various industrial sectors, their classification within different technological tiers at national, state, city, and regional levels, and their growth trajectories. Furthermore, it analyses workforce composition and business longevity to identify the critical trends shaping SME sustainability. By adopting an empirical approach, this research provides valuable insights into how SMEs navigate technological advancement and market competition while striving for sustainable growth.

The findings of this study are significant as they contribute to ongoing policy discussions on strengthening SME competitiveness through targeted interventions such as innovation support, workforce training, and financial assistance. Given that technological innovation is a key driver of SME success, understanding the underlying factors influencing their sustainability can assist policymakers in designing strategic initiatives to support SME growth, particularly in high-tech industries (Gao & Zang, 2021). Additionally, the study's insights can inform industry leaders, government agencies, and financial institutions on effective policy measures to foster a resilient and innovative SME ecosystem in China.

By highlighting the challenges SMEs face at different growth stages, this research contributes to the broader discourse on SME development and offers practical recommendations for enhancing their role in China's evolving economic landscape. Ultimately, this study aims to support SMEs in overcoming barriers to technological innovation, ensuring their long-term competitiveness and sustainability.

Factors Influencing Sustainability and Competitiveness of SMEs

Small and Medium Enterprises (SMEs) play a vital role in economic development, particularly in technology-driven industries, by fostering innovation, job creation, and industrial diversification (Liu et al., 2021). However, the sustainability and competitiveness of SMEs are influenced by various factors, including industry distribution, technological classification,

business growth stage, workforce size, and company longevity. Understanding these elements is crucial for assessing the challenges SMEs face and identifying strategies for their long-term viability (Huang & Zhang, 2021).

Empirical studies have highlighted that SMEs in China predominantly operate in high-tech sectors such as electronics and advanced manufacturing, which require continuous investment in research and development (R&D) to maintain competitiveness (Wang & Liu, 2020). The technological classification of SMEs also varies, with most operating at regional and city levels rather than achieving national or state-level recognition. This classification is indicative of the extent to which SMEs integrate into national innovation ecosystems and their ability to leverage government support for technological advancement (Gao & Zang, 2021). Furthermore, SMEs exhibit diverse growth trajectories, ranging from start-up to stable development stages, with some experiencing stagnation or decline due to financial and market-related constraints (Acs et al., 2019). Workforce size is another critical determinant of SME sustainability, as smaller firms often struggle with limited human capital and technical expertise, which can hinder their ability to scale operations and compete effectively (Zhou & Li, 2020). Additionally, the longevity of SMEs varies significantly, with many businesses failing within the first few years due to market volatility and financial instability (Chen et al., 2022). The following discussion presents an analysis of SME characteristics based on industry distribution, technological levels, growth stages, workforce composition, and business longevity. The findings provide insights into the structural composition of SMEs in China, highlighting key trends that influence their innovation capacity and sustainability.

Table 1.1

SME Characteristics Distribution in China

SME CHARACTERISTICS	Frequency	Percentage%	Accumulated%
Industries			
electronic	56	51.4	51.4
Advanced technology manufacturing	28	25.7	77.1
Bioengineering and new medicine	6	5.5	82.6
Application of new materials	11	10.1	92.7
Environmental protection	3	2.8	95.4
Others	5	4.6	100
Level of technology			
National level	4	3.7	3.7
State level	8	7.3	11.0
City level	67	61.5	72.5
Regional level	30	27.5	100
Growth stage			
start-up stage	16	14.7	14.7
growth stage	21	19.3	33.9
rapid-growth period	33	30.3	64.2
Stable development period	28	25.7	89.9
degenerating stage	11	10.1	100
Number of employees			
0-100	39	35.8	35.8
100-200	28	25.7	61.5
200-300	21	19.3	80.7

300-400	12	11.0	91.7
400-500	9	8.3	100
Period of setting up (year)			
0-1	20	18.3	18.3
1-3	42	38.5	56.9
4-5	27	24.8	81.7
5-10	16	14.7	96.3
10 or above	4	3.7	100

Small and Medium Enterprises (SMEs) are integral to economic development, particularly in technology-driven industries, as they contribute to innovation, job creation, and industrial diversification (Liu et al., 2021). However, the sustainability and competitiveness of SMEs are influenced by multiple factors, including industry distribution, technological classification, business growth stage, workforce size, and company longevity. Understanding these elements is essential in addressing the challenges SMEs face and formulating strategies to enhance their long-term viability (Huang & Zhang, 2021).

Empirical research indicates that SMEs in China predominantly operate in high-tech sectors, including electronics and advanced manufacturing, which necessitate continuous investment in research and development (R&D) to maintain competitiveness (Wang & Liu, 2020). The technological classification of SMEs varies, with most functioning at regional and city levels rather than achieving national or state-level recognition. This categorization reflects the extent to which SMEs integrate into national innovation ecosystems and their ability to leverage government support for technological advancement (Gao & Zang, 2021).

Moreover, SMEs exhibit diverse growth trajectories, ranging from the start-up phase to a stable development stage, with some experiencing stagnation or decline due to financial and market-related constraints (Acs et al., 2019). Workforce size is another critical determinant of SME sustainability, as smaller firms often encounter limitations in human capital and technical expertise, which hinder scalability and market competitiveness (Zhou & Li, 2020). Additionally, business longevity varies significantly, with many SMEs failing within the first few years due to market volatility and financial instability (Chen et al., 2022).

Analysis of SME Characteristics

Industry Distribution and Technological Classification

The study reveals that the electronics sector dominates SME operations (51.4%), followed by advanced technology manufacturing (25.7%) and bioengineering (5.5%). These trends align with China's industrial strategy, which emphasizes high-tech development. However, sustaining innovation in these sectors necessitates ongoing R&D investment, skilled workforce acquisition, and government support (Nambisan, 2020).

A significant proportion of SMEs operate at the city level (61.5%), while regional-level enterprises comprise 27.5%, and national-level firms account for only 3.7%. These findings suggest that technological innovation is concentrated in urban centres, benefiting from proximity to research institutions, industrial clusters, and policy incentives (Autio et al., 2021). However, the limited national-level presence implies that many SMEs struggle with scaling their innovations to broader markets due to financial and infrastructural constraints (Giones & Brem, 2019).

Growth Stages and Workforce Composition

SMEs demonstrate varied growth patterns, with 30.3% in the rapid-growth stage and 25.7% in a stable development phase. Conversely, 14.7% of SMEs remain in the start-up phase, while 10.1% are in the degenerating stage. These findings underscore the necessity for targeted interventions to support start-ups in overcoming financial and operational barriers. High-growth SMEs require sustained financial backing, innovation policies, and strong market linkages to maintain expansion (Coad et al., 2022). Government incentives, such as tax reductions and digitalization programs, can aid SMEs in transitioning from early-stage ventures to established enterprises (World Bank, 2021).

Workforce composition significantly impacts SME performance. The study shows that most SMEs employ fewer than 100 workers (35.8%), while only 8.3% have a workforce exceeding 400 employees. This suggests that scalability remains a challenge, affecting innovation output and market penetration. Research indicates that investing in employee training, leadership development, and digital skills can enhance SME resilience and productivity (Delmar et al., 2019). Furthermore, China's evolving labour market requires policies that promote workforce retention and skill development to ensure SME sustainability (Eurostat, 2022).

Business Longevity and Sustainability

Business longevity is a crucial determinant of SME sustainability. The study finds that 38.5% of SMEs have been established within the last 1–3 years, while only 3.7% have operated for more than 10 years. These statistics highlight the challenges associated with long-term sustainability, including financial instability, market competition, and technological obsolescence (Shane, 2020). The high failure rates among early-stage SMEs underscore the importance of financial assistance, mentoring programs, and digital transformation initiatives to support long-term growth (Audretsch & Link, 2021). Strengthening SME resilience through policy frameworks and industry partnerships can mitigate business failure risks and enhance sustainability.

The findings emphasize the critical role of industry distribution, technological classification, growth stage, workforce size, and business longevity in determining SME sustainability. While China's SME sector remains heavily concentrated in high-tech industries, challenges such as limited national-level expansion, workforce constraints, and financial instability persist. Addressing these issues through targeted policies, R&D investment, workforce development, and innovation incentives is essential for ensuring the long-term growth and competitiveness of SMEs.

Conclusion

This study provides critical insights into the technological innovation and sustainability of SMEs in China. The findings highlight the predominance of technology-driven SMEs in urban centers, the challenges associated with workforce scalability, and the diverse growth trajectories of businesses. These results underscore the need for targeted policies that foster SME innovation, workforce development, and financial resilience. Government interventions, including tax incentives, digital upskilling initiatives, and financial support schemes, play a pivotal role in ensuring the long-term sustainability of SMEs. Future research should examine the impact of China's digital transformation policies on SME competitiveness and investigate the influence of global market integration on their sustainability. Addressing these key areas

will contribute to a deeper understanding of SME development within China's rapidly evolving economic landscape and inform strategies for enhancing their long-term viability.

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