Internationalisation Is Not a Natural Outcome of Firm Capabilities: The Pivotal Role of Competitive Advantage in High-tech SMEs' Capability Transformation

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Abstract

Against the backdrop of rapid technological iteration and deep restructuring of global value chains, high-tech small and medium-sized enterprises (SMEs) have become pivotal actors in driving regional innovation and industrial upgrading. However, the mechanisms through which firms' internal capabilities are effectively transformed into internationalisation outcomes remain insufficiently articulated. Drawing on Dynamic Capabilities Theory and the Uppsala model of internationalisation, this study focuses on high-tech SMEs in Langfang and develops an analytical framework linking firm capabilities, international competitive advantage, and the degree of internationalisation. Using data from 392 valid questionnaires and applying partial least squares structural equation modelling (PLS-SEM), the study systematically examines the direct effects of technological innovation capability, absorptive capacity, policy support intensity, managerial international experience, and transnational network capability on firms' degree of internationalisation, as well as their indirect effects mediated by international competitive advantage. The results indicate that all examined firm capabilities significantly enhance the degree of internationalisation, with technological innovation capability and absorptive capacity exerting both direct positive effects and serving as core endogenous sources of international competitive advantage. Whereas the effects of policy support, managerial international experience, and transnational network capability are largely realised through the mediating role of international competitive advantage. Further mediation analysis confirms that international competitive advantage plays a stable and pivotal bridging role in transforming firm capabilities into internationalisation outcomes. These findings demonstrate that firm capabilities do not automatically translate into internationalisation performance. Instead, such capabilities must be systematically shaped and externalised through competitive advantage to be effectively recognised by international markets. This deepens the process-oriented explanation of SME internationalisation from a dynamic capability perspective and provides empirical insights for optimising internationalisation pathways and policy support mechanisms for regional high-tech SMEs.

Keywords

High-tech SMEs, Dynamic capabilities, Uppsala model, International competitive advantage, Partial least squares structural equation modelling

Introduction

Against the backdrop of the ongoing new wave of technological revolution and industrial transformation worldwide, innovation-driven development has become a central pathway through which countries enhance economic resilience and international competitiveness. As shown in Figure 1, high-tech small and medium-sized enterprises (SMEs) are widely regarded as the most dynamic and potentially disruptive actors in this process. According to the latest research by the OECD, high-tech SMEs account for more than 60% of new technology diffusion and nearly half of disruptive innovation outcomes in developed economies. Their flexible organisational structures and rapid technological responsiveness enable them to demonstrate stronger strategic adaptability in highly uncertain international market environments [1]. At the same time, global value chains are undergoing profound restructuring, shifting from an efficiency-oriented logic towards a dual emphasis on capability building and security considerations shown in Figure 2. Factors such as

technological standards, intellectual property protection, compliance systems, and transnational collaboration networks are increasingly replacing low-cost inputs as the key thresholds that firms must overcome to access international markets [2]. Within this context, whether firms are able to continuously transform internal capabilities into stable and replicable international competitive advantages has emerged as a critical determinant of success or failure in the internationalisation process.

Figure 1. High-tech SMEs as key vehicles for innovation and technology diffusion.

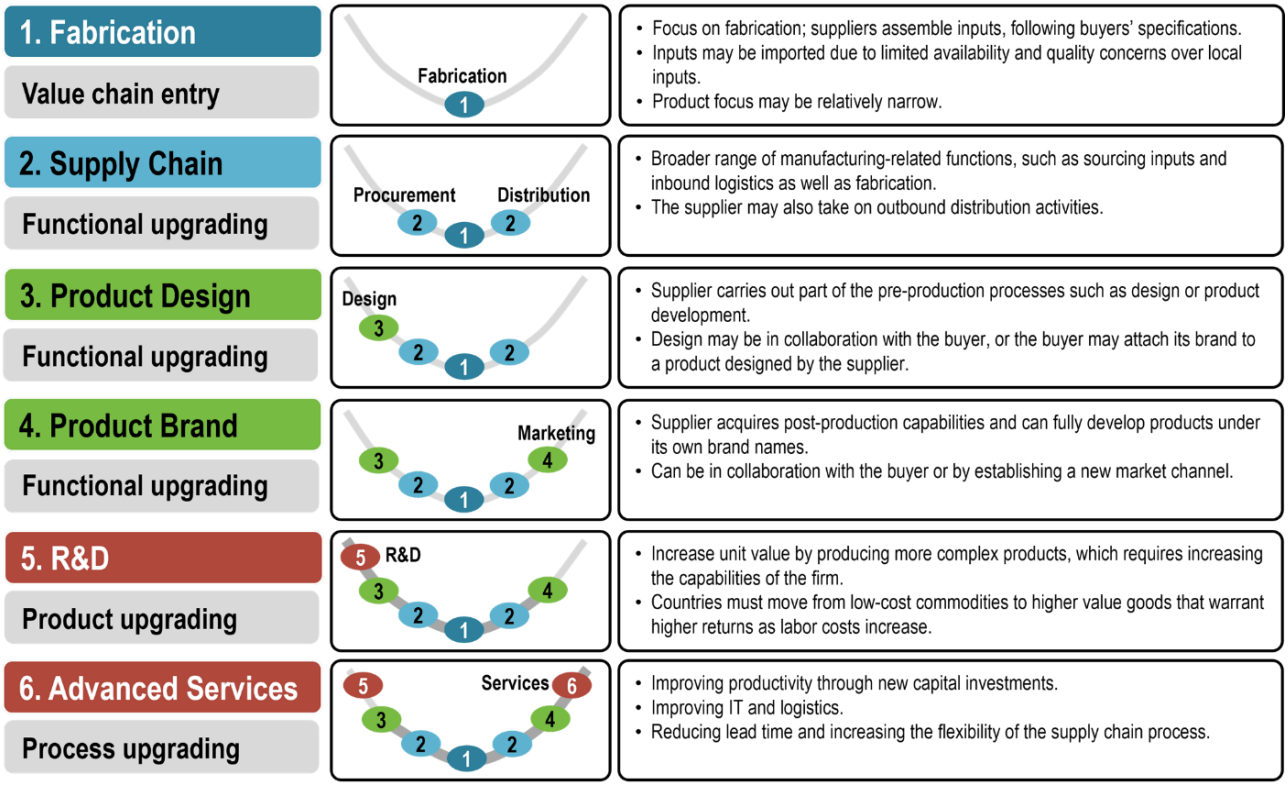

Figure 2. Global value chain restructuring: from efficiency-oriented to capability and security-oriented.

In the Chinese context, both the scale and technological output of high-tech small and medium-sized enterprises (SMEs) have expanded substantially over the past decade. Data from the National Bureau of Statistics of China

show that by the end of 2023, the number of high-tech enterprises nationwide had exceeded 400,000, of which more than 90% were SMEs, and their R&D investment intensity has consistently remained above the average level of large-scale industrial enterprises [3]. Notably, the growth of high-tech sectors (e.g., chipmaking equipment) has been paired with dynamic equity investment patterns. Figure 3 tracks 2021-2023 investment shifts: total investment peaked at ~$6.2B (2021), fell to ~$1.5B (2022), then rebounded to ~$2.8B (2023). State-owned enterprises (SOE) and private investments followed this down-then-up trend, while central government investment remained near $0. This volatility may reflect the sector's reliance on market capital, potentially constraining SMEs' long-term R&D and international-isation capacity [4]. In sharp contrast to the rapid growth in technological investment and innovation output, however, the overall level of internationalisation among Chinese high-tech SMEs remains relatively low. Statistics released by the Ministry of Commerce are presented in Figure 4. According to these statistics, fewer than 15% of small and medium-sized enterprises (SMEs) in the high-tech sector engage in sustained exporting or substantive cross-border operations. Most of these firms remain concentrated in the mid-to-low end segments of global value chains. Their participation in international markets is primarily characterised by passive export activities [5]. Existing studies widely suggest that this misalignment between rising innovation capability and limited inter-nationalisation outcomes cannot be attributed solely to constraints in resource scale. Rather, it is closely associated with firms' insufficient internal mechanisms for systematically integrating technological, knowledge, and organisational capabilities and transforming them into international competitive advantage [6]. Vietnam 2023 data based on average growth of last 5 years. Hong Kong's post-2017 surge is driven by re-exports, not manufacturing.

To further contextualize these trends, Figure 4 illustrates that China's high-tech exports reached USD 825 billion in 2023, accounting for 24% of the global total - a figure that underscores the nation's dominant position in global high-tech manufacturing. However, this aggregate export strength masks the limited internationalisation of most high-tech SMEs, which remain largely confined to domestic markets and low-value-added export activities. This discrepancy between macro-level export dominance and micro-level SME internationalisation highlights a critical paradox: while China excels in scaling high-tech production, its SMEs struggle to translate innovation into sustained global market presence.

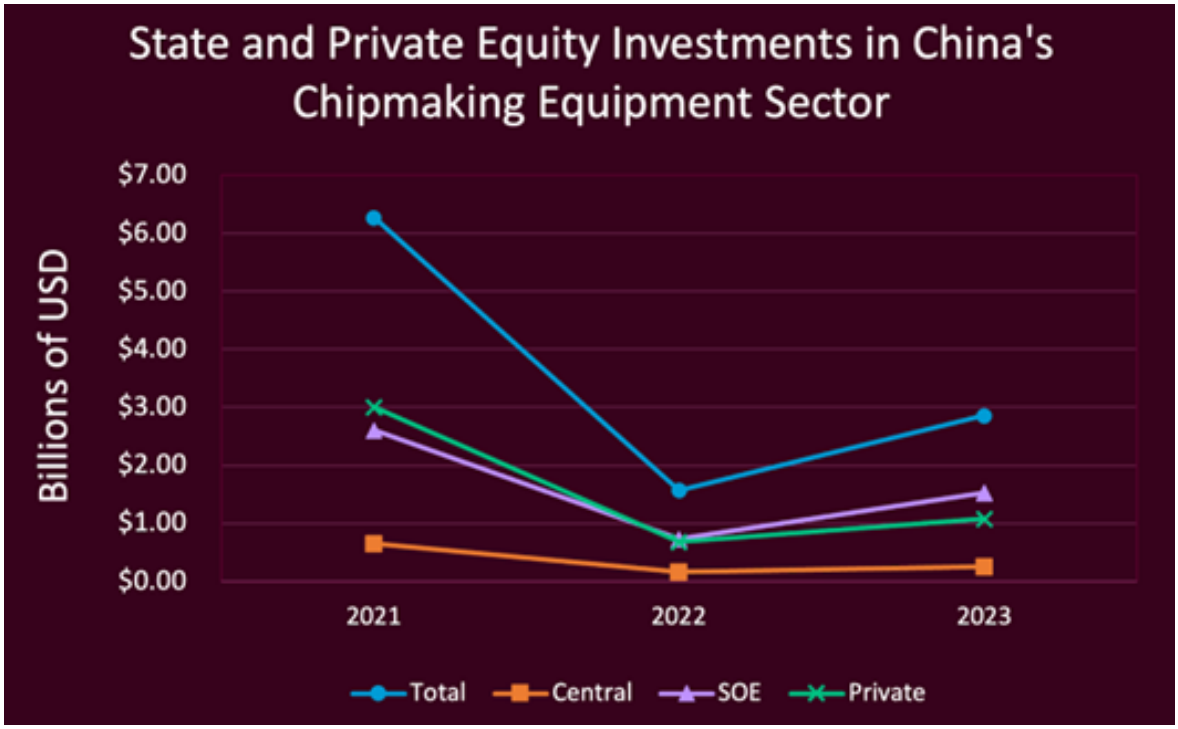

Figure 3. State and private equity investments in China's chipmaking equipment seceor (Source: World Bank, WIPO, ANDA MAN PARTNERS Analysis).

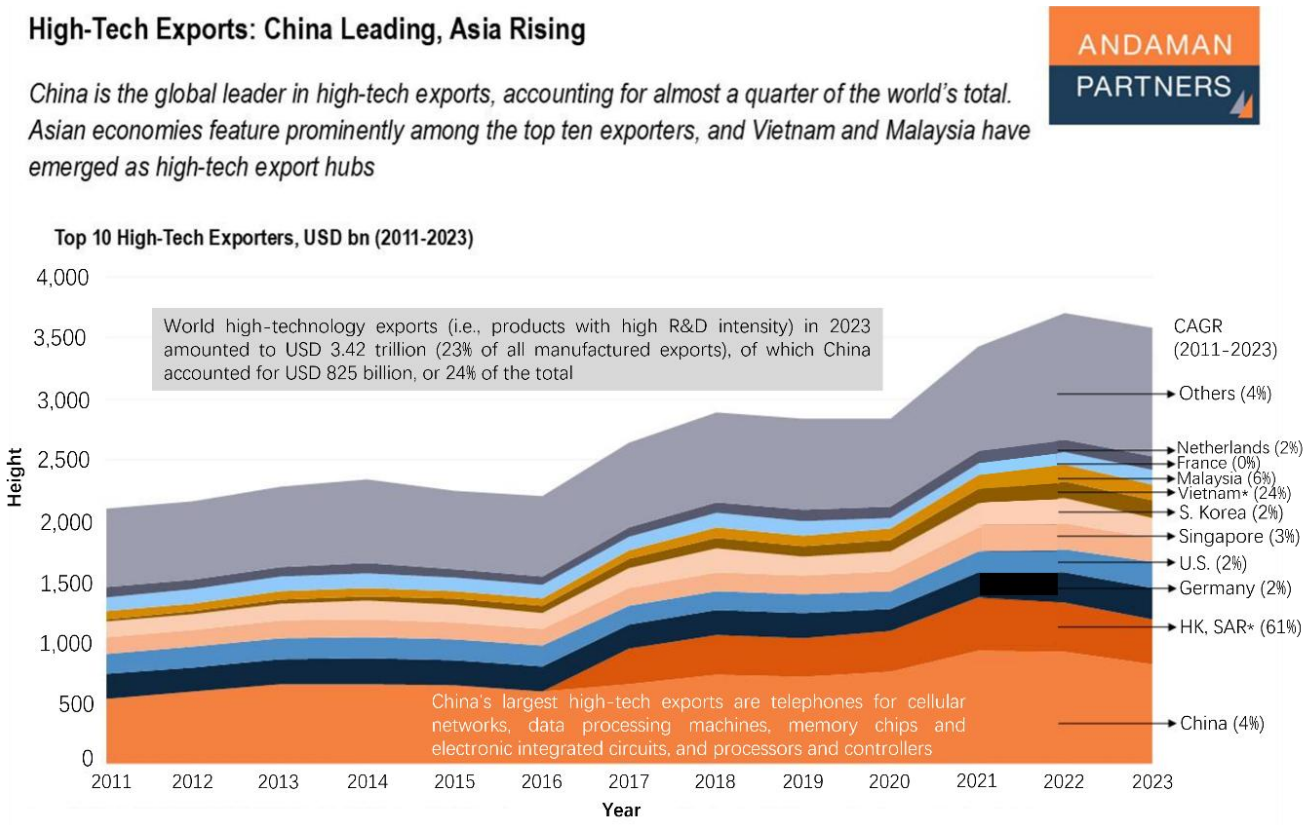

Figure 4. 2011-2023 High-tech export scale of the world's Top 10 countries/regions: China's leadership and Asia's rise (Source: World Bank, WIPO, ANDAMAN PARTNERS Analysis).

From a regional perspective (shown in Figure 5), Langfang is located at a strategic node within the Beijing-Tianjin-Hebei coordinated development initiative. It is adjacent to Beijing's major science and technology innovation hub and Tianjin's international port cluster. Thus, the city enjoys notable comparative advantages in locational conditions, industrial support systems, and policy environment.

As a core node in the Beijing-Tianjin-Hebei (BTH) integration strategy, Langfang's geographic proximity to Beijing's Zhongguancun Science Park and Tianjin Port enables efficient knowledge transfer and logistics access. This positioning facilitates the city's integration into national and regional value chains In recent years, benefiting from the spillover of technological achievements from Beijing and the continuous advancement of regional industrial collaboration mechanisms, Langfang has gradually developed diversified high-tech industrial clusters. As Figure 6 shows, Langfang also hosts an engineering rubber cluster, aligning with its high-end equipment manufacturing sector to enrich local industrial diversity. These clusters cover key sectors including electronic information, new materials, high-end equipment manufacturing, and biomedicine. According to data released by the Hebei Provincial Department of Science and Technology, as of 2024, the number of valid high-tech enterprises in Langfang has exceeded 1,400, while the number of technology-based SMEs has surpassed 1,700, with many key core technologies originating from joint R&D projects between local firms and universities and research institutes in Beijing [7,8]. Nevertheless, even though some firms have developed relatively solid technological innovation and absorptive capacities, their participation in international markets remains noticeably lagging. In practice, issues such as a relatively homogeneous international customer structure, insufficient embeddedness in transnational networks, and limited international brand influence are widely observed. This structural tension - characterised by a relatively strong capability base but weak internationalisation outcomes. It renders high-tech SMEs in Langfang a representative empirical context for examining how regional innovation capabilities in China are translated into internationalisation performance.

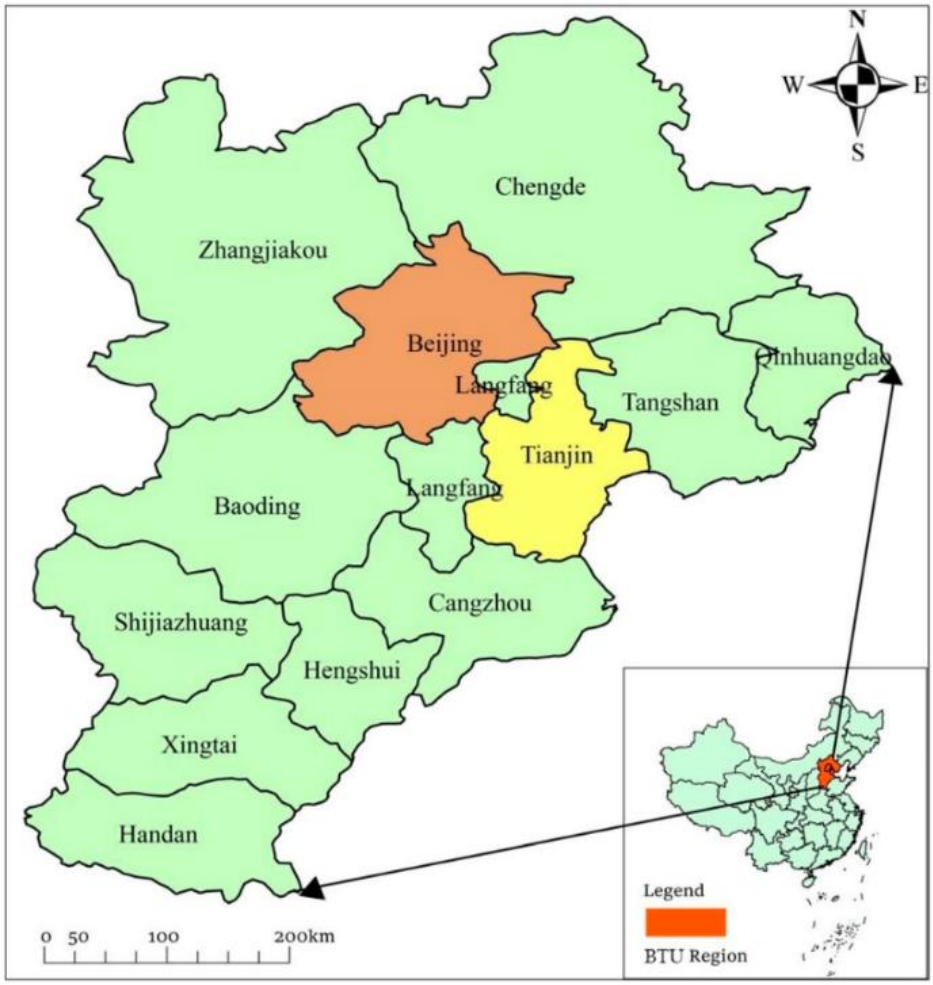

Figure 5. Strategic geographical location of Langfang in the Beijing-Tianjin-Hebei (BTU) region.

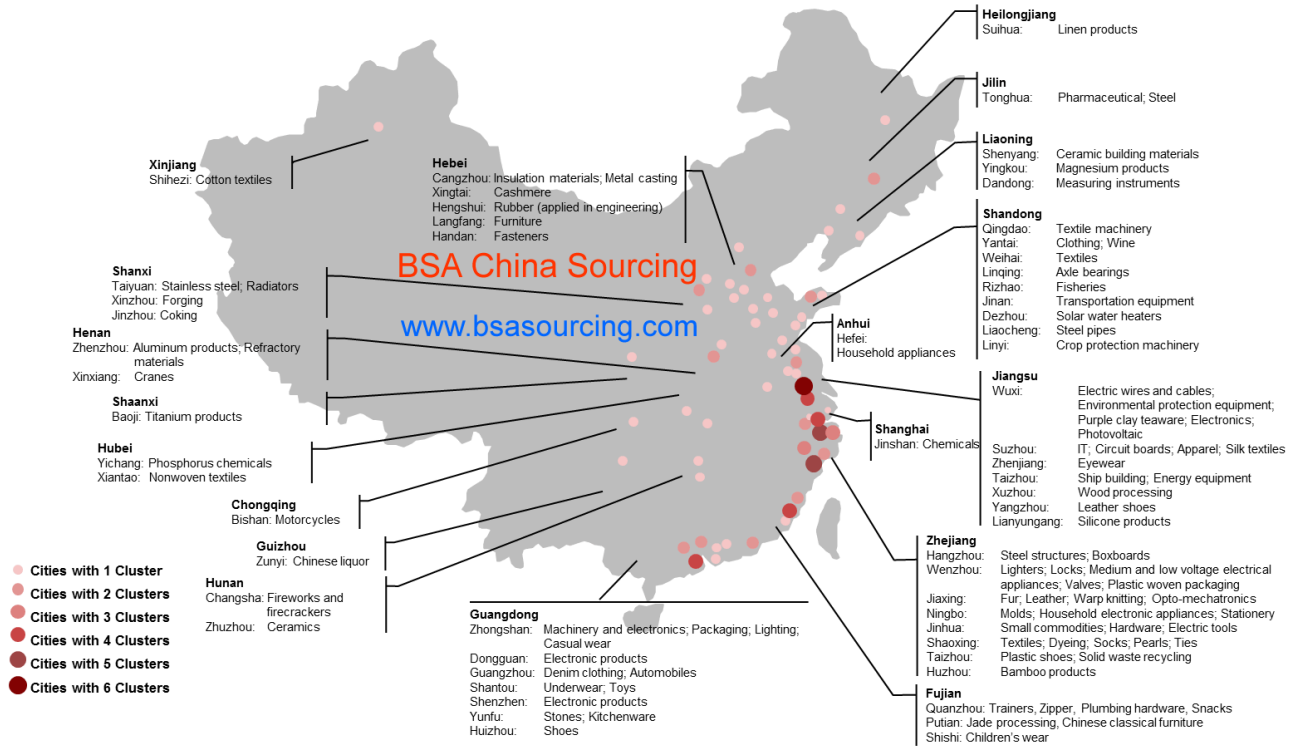

Figure 6. Geographic distribution of industrial clusters and sourcing locations for BSA China sourcing across Chinese cities (Source: Li & Fung Research Centre; The Beijing Axis Analysis).

Against the above practical background, explaining firms' internationalisation behaviour solely from the perspectives of market entry modes or external environmental constraints is no longer sufficient to address the key challenges observed in practice. Therefore, it is necessary to return to the level of firms' internal capabilities and systematically examine the transformation path of endogenous factors into sustainable internationalisation outcomes. The core endogenous factors under investigation include technological innovation capability, absorptive capacity, managerial capability, and transnational network capability. International competitive advantage is identified as the critical mediating mechanism that underpins the conversion of these internal capabilities into tangible internationalisation performance. Dynamic Capabilities Theory and the Uppsala model of incremental internationalisation provide important theoretical foundations for understanding this transformation process. However, systematic empirical evidence at the level of regional high-tech SMEs in China remains relatively limited. Focusing on high-tech SMEs in Langfang, this study seeks to uncover the internal mechanisms linking firm capabilities, international competitive advantage, and the degree of internationalisation within a specific regional context. Thereby, addressing existing gaps in the literature concerning both regional-level analysis and capability-to-outcome transformation mechanisms.

Research logic and conceptual framework

Theoretical foundations

Dynamic Capabilities Theory, as an important extension of the Resource-Based View, emphasises that firms operating in highly uncertain and rapidly changing environments must continuously integrate, reconfigure, and renew their resources and capabilities in order to obtain and sustain competitive advantage. In his subsequent work, Teece argues that firm competitiveness does not stem from the stock of resources per se, but rather from the firm's capability architecture that enables it to sense opportunities, seize them, and reconfigure resource allocations accordingly - a process characterised by strong dynamics and path dependence [9]. Against the backdrop of global value chain restructuring and increasingly shortened technological cycles, high-tech SMEs are particularly reliant on dynamic capabilities to cope with institutional changes, technological uncertainty, and cross-border market risks. For high-tech SMEs in Langfang, firm development is simultaneously embedded in local policy environments, regional innovation networks, and international market systems. Whether firms can effectively integrate technological innovation capability, absorptive capacity, managerial international experience, and transnational network capability directly determines their ability to form internationally transferable competitive advantages. Recent studies further indicate that dynamic capabilities do not translate directly into performance outcomes. Instead, they often exert an indirect influence on the depth and breadth of internationalisation by shaping firms' competitive advantage structures in international markets [10,11]. Accordingly, in this study, Dynamic Capabilities Theory not only explains why different types of firm capabilities exert heterogeneous effects, but also provides a solid theoretical foundation for the mediating mechanism through which firm capabilities are transformed into internationalisation outcomes via international competitive advantage.

The Uppsala model of internationalisation, by contrast, elucidates the evolutionary logic of firm internationalisation from a process perspective, emphasising that internationalisation is not a one-off strategic decision, but a gradual and dynamic process accompanied by the accumulation of knowledge and changes in risk perception. The original model posits that firms, due to limited experience in foreign markets, tend to begin with low-commitment entry modes and gradually increase resource commitment as market knowledge accumulates, thereby enhancing their degree of internationalisation. In later revisions, Vahlne introduces a network perspective, highlighting that firms' embeddedness in business networks plays a critical role in acquiring foreign market knowledge, reducing uncertainty, and accelerating the internationalisation process [12]. Recent research suggests that this theoretical framework remains highly applicable to explain the internationalisation behaviour of high-tech SMEs. Particularly in knowledge-intensive industries, where capability enhancement is often first reflected in improved perceptions of international market

uncertainty and deeper network embeddedness, rather than immediate leaps in internationalisation performance [13,14]. In the present study, the Uppsala model provides an important explanatory pathway for understanding how firm capabilities facilitate the transition from low-commitment internationalisation modes to higher levels of international engagement. This transition is driven by the enhancement of three core dimensions: market knowledge, network relationships, and risk management capabilities. Integrating the Uppsala model with Dynamic Capabilities Theory enables a systematic examination of the internal logic underlying the internationalisation outcomes of high-tech SMEs in Langfang from both capability formation and internationalisation evolution perspectives.

Research hypotheses

From the perspective of Dynamic Capabilities Theory, firm internationalisation is not a natural spillover of capability accumulation, but rather a transformation process in which accumulated capabilities are converted into internationalisation outcomes through the formation of competitive advantage as a critical mediating mechanism. For high-tech small and medium-sized enterprises (SMEs), technological innovation capability, absorptive capacity, policy support intensity, managerial international experience, and transnational network capability jointly constitute the core capability base for engaging in international activities. These capabilities do not automatically translate into internationalisation outcomes; only when firms establish relatively stable and sustainable competitive advantages in international markets can accumulated capabilities further promote a higher degree of internationalisation [15]. Accordingly, international competitive advantage plays a pivotal mediating role in the transformation of firm capabilities into internationalisation outcomes.

First, different types of firm capabilities are widely regarded as important sources of competitive international advantage. Technological innovation capability enables firms to establish differentiation advantages in products and technologies. Absorptive capacity enhances firms' efficiency in integrating and exploiting external international knowledge [16]. Policy support intensity provides institutional and resource guarantees for capability development and international expansion. Managerial international experience influences how firms identify and evaluate international opportunities and risks. Transnational network capability facilitates resource acquisition and knowledge sharing through network embeddedness. Based on the above reasoning, the following hypotheses are proposed:

H_1: Technological innovation capability has a significant positive effect on international competitive advantage.

H_2: Absorptive capacity has a significant positive effect on international competitive advantage.

H_3: Policy support intensity has a significant positive effect on international competitive advantage.

H_4: Managerial international experience has a significant positive effect on international competitive advantage.

H_5: Transnational network capability has a significant positive effect on international competitive advantage.

Furthermore, firm capabilities do not directly lead to international market expansion outcomes. Instead, their effects are realised through the mediating mechanism of international competitive advantage. By reducing uncertainty in international markets, improving resource allocation efficiency, and enhancing firms' legitimacy and recognition in international markets, international competitive advantage effectively transforms firm capabilities into higher levels of international engagement. Based on this logic, the following mediation hypotheses are proposed:

H_6: International competitive advantage mediates the relationship between technological innovation capability and the degree of internationalisation.

H_7: International competitive advantage mediates the relationship between absorptive capacity and the degree of internationalisation.

H_8: International competitive advantage mediates the relationship between policy support intensity and the degree of internationalisation.

H_9: International competitive advantage mediates the relationship between managerial international experience and the degree of internationalisation.

H_{10}: International competitive advantage mediates the relationship between transnational network capability and the degree of internationalisation.

Research methodology

Research design

This study employs a quantitative approach with a

descriptive research design. It uses cross-sectional data to systematically explore how core capabilities of Langfang's high-tech SMEs translate into internationalisation outcomes. Additionally, it incurporates international competitive advantage as a key mediating mechanism into the analytical framework [17]. The research population consists of high-tech SMEs legally registered and continuously operating in Langfang. A key inclusion criterion requires these firms to have undertaken at least one concrete internationalisation-related activity within the past three years. Such activities include export operations, overseas client cooperation, cross-border supply chain collaboration, international exhibition participation, and overseas market channel development. Langfang was selected as the empirical context primarily due to its strategic locational advantages within the Beijing-Tianjin-Hebei coordinated development strategy and its pronounced clustering of technology-based enterprises.

At the same time, firms in this region exhibit substantial heterogeneity in terms of resource allocation, international experience, and market expansion. Therefore, it is particularly suitable for examining the internal mechanisms through which firm capabilities are translated into internationalisation outcomes. According to publicly available information, as of 2024, the number of valid high-tech enterprises in Langfang has exceeded 1,400, while the number of nationally registered technology-based SMEs has surpassed 1,750, providing a solid empirical basis for constructing the sampling frame.

With respect to the sampling strategy, this study accounts for two critical constraints related to data collection. These constraints include the sensitivity of firm internationalisation information and managerial experience, as well as the difficulty of acquiring high-quality data via pure random sampling. Accordingly, the study adopts a non-probability sampling approach that integrates stratified purposive sampling and snowball sampling. Districts/counties and industry categories are used as stratification criteria, and eligible firms are identified through publicly available lists from science and technology authorities, industrial park service agencies, industry associations, and entrepreneur networks. Priority is given to inviting middle- and senior-level managers who are well informed about firms' internationalisation activities and capability development to complete the questionnaire. Regarding sample size, the proposed research model includes multiple latent variables and mediating paths, making it well suited for partial least squares structural equation modelling (PLS-SEM) using SmartPLS. Based on model complexity, an expected medium effect size, conventional significance levels, and minimum sample size estimations derived from the inverse square root method and the gamma-exponential method, the minimum required effective sample size was set at no fewer than 200 observations. To enhance the stability of parameter estimation and the statistical power of mediation effect testing, the target effective sample size was further increased to over 350. During the formal survey stage, a total of 520 questionnaires were distributed, of which 423 were returned. After excluding responses with substantial missing data, highly uniform response patterns, or evident logical inconsistencies, 392 valid questionnaires were retained for subsequent empirical analysis. Minimum Sample Size Estimated Using the Inverse Square Root Method, as shown in Equation (1):

$$N \geq \left(\frac{z_1 - \frac{a}{2}}{\beta_{min}} \right)^2 \quad (1)$$

Where: N denotes the minimum required sample size, $z_1 - a/2$ represents the critical value of the standard normal distribution corresponding to the given significance level. a denotes the significance level. β_{min} represents the minimum path coefficient (effect size) that the study aims to detect.

In this study, in line with commonly adopted significance criteria in social science research, the significance level is set at 0.05, and the corresponding two-tailed critical value is:

$$z_1 - \frac{a}{2} = 1.96 \quad (2)$$

$$\beta_{min} = 0.20 \quad (3)$$

Substituting the above parameters into the formula yields the following result (with the minimum detectable effect size set at a medium level):

$$N \geq \left(\frac{1.96}{0.20} \right)^2 = (9.8)^2 = 96.04 \quad (4)$$

Building upon the inverse square root method, this

approach incorporates model structural complexity, with particular emphasis on the effects of the number of structural paths, the number of endogenous latent variables, and mediating structures on estimation precision.

$$N \geq \gamma \times \left(\frac{z_1 - \frac{a}{2}}{\beta_{min}} \right)^2 \quad (5)$$

Where: γ denotes the model complexity adjustment coefficient.

Its value typically increases with the number of incoming structural paths associated with the most complex endogenous latent variable in the model.

According to the empirical recommendations provided by Kock and Hadaya, in multi-path models of this type, the gamma coefficient is typically no lower than 2 [18]. Therefore, under the same significance level and minimum effect size assumptions, the sample size estimated using the gamma exponent method is:

$$N \geq 2 \times 96.04 = 192.08 \quad (6)$$

Measurement of variables

About variable measurement and questionnaire design, all latent variables in this study are operationalised based on well-established measurement scales, with item wording appropriately adapted to the context of high-tech SMEs in Langfang (see Table 1). A five-point Likert scale is uniformly employed, where 1 represents "strongly disagree" and 5 represents "strongly agree". Technological innovation capability is used to capture firms' comprehensive capabilities in new product development, process improvement, and technological upgrading. The measurement items are primarily adapted from classical innovation capability scales and revised in line with measurement approaches commonly used in studies on the internationalisation of high-tech firms [19,20]. Absorptive capacity is opera-tionalised across four dimensions: acquisition, assimilation, transformation, and exploitation. This measurement scale is originally developed by Flatten et al. and has been extensively validated in cross-national empirical studies [21]. Policy support intensity assesses the extent to which firms receive fiscal subsidies, tax incentives, public services, and policy accessibility in the processes of R&D, innovation, and internationalisation. The items are designed with reference to operationalisations of institutional support in SME internationalisation research and adjusted to reflect local science and technology policy practices [22]. Managerial international experience is measured using structured indicators, including whether key managers possess overseas education or work experience, experience in managing international projects, and long-term cooperation with foreign clients or partners. The measurement approach follows established practices in research on top management team international experience [23]. Transnational network capability reflects firms' ability to build and leverage cross-border relational networks, with items covering network breadth, depth, and coordination efficiency, adapted from mature network capability scales and revised for export and cross-border cooperation contexts [24]. International competitive advantage, as the mediating variable, captures firms' relative advantage vis-à-vis international competitors, with dimensions including cost efficiency, technological or product differentiation, market entry capability, and responsiveness, adapted from measurement approaches used in studies of export competitive advantage. The degree of internationalisation, the study's outcome variable, is measured via a composite indicator set that captures both the depth and breadth of firms' international market participation.

These indicators include export intensity, number of overseas markets, foreign client/channel stability, and the presence of overseas subsidiaries or long-term cross-border operations. This operationalisation aligns with widely adopted measures in research on the dynamic capabilities-internationalisation relationship. Prior to formal data collection, expert interviews and a small-scale pre-test were conducted to assess item clarity and contextual appropriateness, followed by a pilot test to evaluate preliminary reliability, item loadings, and structural adequacy; based on the results, minor refinements were made to selected items before proceeding to the formal survey stage.

Table 1. Measurement of constructs and scale sources.

Construct	Measurement description	Scale source
Technological innovation capability	Measured by items capturing the firm's overall capability in new product development, process improvement, and technological upgrading. The scale reflects the firm's ability to continuously introduce innovations and adapt technologies to international market requirements. All items were adapted to the context of high-tech SME internationalisation.	Calantone, Cavusgil, & Zhao (2002) Chung & Yoon (2020)
Absorptive capacity	Operationalised using four dimensions: knowledge acquisition, assimilation, transformation, and exploitation. The scale assesses the firm's ability to identify, absorb, integrate, and apply external knowledge for commercial purposes.	Flatten, Engelen, Zahra, & Brettel (2011)
Policy support intensity	Measured by items assessing the extent to which firms receive institutional support during R&D, innovation, and internationalisation processes, including financial subsidies, tax incentives, public services, and accessibility of government policies. Items were adapted to reflect local science and technology policy conditions.	Georgieva (2020)
Managerial international experience	Measured using structured indicators capturing whether key executives possess overseas study or work experience, international project management experience, and long-term collaboration with foreign clients or partners. The measurement reflects the international exposure and global orientation of the top management team.	Cuypers, Patel, & Ertug (2021); Piaskowska & Trojanowski (2022)
Transnational network capability	Measured by items reflecting the firm's capability to establish, coordinate, and leverage cross-border relationship networks. The scale captures network breadth, relational depth, and coordination efficiency in export and international cooperation contexts.	Walter, Auer, & Ritter (2006); Mitręga, Forkmann, Ramos, & Henneberg (2023)
International competitive advantage (mediator)	Measured by items capturing the firm's competitive position relative to international competitors, including cost efficiency, technological or product differentiation, market entry capability, and responsiveness to international market changes.	Ngo, Janssen, Falize, & Hult (2024)
Degree of internationalisation	Measured using composite indicators reflecting both the depth and breadth of international market participation, including export intensity, number of foreign markets served, stability of overseas customers or channels, and the presence of overseas subsidiaries or long-term cross-border operations.	Fredrich, Bouncken, & Kraus (2022)

Data analysis procedures

With respect to data analysis and ethical considerations, this study follows a two-stage analytical procedure involving the assessment of the measurement model and the structural model, with all estimations conducted using SmartPLS (see Table 2). In the measurement model stage, internal consistency reliability and convergent validity of the latent variables are examined by calculating Cronbach's alpha, composite reliability, and average variance extracted (AVE). Discriminant validity is assessed using cross-loadings and the heterotrait-monotrait ratio (HTMT), while variance inflation factors

(VIFs) are employed to evaluate potential multicollinearity risks. In the structural model stage, the analysis focuses on evaluating path coefficients and their statistical significance, the coefficient of determination (R^2), and predictive relevance (Q^2). Bootstrapping resampling procedures are applied to compute confidence intervals for both direct and indirect effects, thereby testing the mediating role of international competitive advantage.

To enhance the robustness of the empirical findings, potential common method bias is addressed at both the research design and analysis stages. Procedural remedies such as anonymous participation and randomised item presentation are implemented, in combination with statistical tests, to mitigate systematic bias arising from single-source data. Where appropriate, multi-group analysis or heterogeneity tests are further conducted to examine the stability of path relationships across firms of different sizes or industry backgrounds. From an ethical standpoint, the questionnaire cover page clearly informs respondents of the research purpose, data usage, and their rights as participants, emphasising voluntary participation and the right to withdraw at any time. No personally or organisationally identifiable information is collected, and all data are used exclusively for academic research purposes. These data are stored in encrypted, access-restricted systems, ensuring alignment between methodological rigour and the protection of respondents' rights and interests.

Table 2. Data analysis procedure.

Analysis stage	Methods and indicators	Software / References
Measurement model assessment	(1) Cronbach's α (2) Composite Reliability (CR) (3) Average Variance Extracted (AVE)	SmartPLS Hair et al. (2022)
Discriminant validity assessment	(1) Cross-loadings (2) Heterotrait-Monotrait ratio (HTMT)	SmartPLS Hair et al. (2022)
Multicollinearity diagnosis	Variance Inflation Factor (VIF)	SmartPLS Hair et al. (2022)
Structural model evaluation	(1) Path coefficients and significance levels (2) Coefficient of determination (R^2) (3) Predictive relevance (Q^2)	SmartPLS Hair et al. (2022)
Mediation analysis	(1) Bootstrapping resampling (2) Confidence intervals for direct and indirect effects	SmartPLS Hair et al. (2022)
Robustness and heterogeneity analysis	(1) Multi-group analysis (MGA) (2) Heterogeneity tests by firm size or industry	SmartPLS Hair et al. (2022)
Common method bias control	(1) Procedural remedies (2) Statistical diagnostics	SmartPLS Podsakoff et al. (2003) Hair et al. (2022)

Empirical results

Sample characteristics and validity

This study employs a questionnaire survey to collect sample data. During the formal data collection stage, a total of 520 questionnaires were distributed to high-tech small and medium-sized enterprises (SMEs) in Langfang, of which 423 were returned. In the data screening process, questionnaires with substantial missing values, highly uniform response patterns, or evident logical inconsistencies were excluded based on criteria related to missing data proportions, response consistency, and logical validity.

As a result (see Table 3), 392 valid questionnaires were retained, yielding an effective response rate of 75.4%. This sample size far exceeds the minimum threshold estimated via the inverse square root method and the gamma-exponential method, which requires no fewer than 200 observations. It also meets the sample adequacy criteria for partial least squares structural equation

modelling (PLS-SEM) with multiple latent variables and mediating structures.

In terms of sample characteristics shown in Table 4, the respondents primarily consist of middle- and senior-level managers. The distributions of gender, age, and educational attainment are relatively balanced. The firm sample is mainly drawn from high-tech industries such as electronic information, high-end equipment manufacturing, new materials, and biomedicine, with small and medium-sized firms accounting for the majority of observations. Overall, the sample structure closely corresponds to the actual distribution of high-tech SMEs in Langfang, thereby providing a reliable empirical basis for the subsequent analyses.

Table 3. Questionnaire distribution and sample validity.

Item	Number of questionnaires	Percentage (%)
Questionnaires distributed	520	100.0
Questionnaires returned	423	81.3
Invalid questionnaires excluded	31	5.9
Final valid sample	392	75.4

Table 4. Sample characteristics of respondents and firms (N = 392).

Category	Variable	Classification	Frequency	Percentage (%)
Respondent characteristics	Gender	Male	243	62.0
		Female	149	38.0
	Age	≤30 years old	54	13.8
		31-40 years old	176	44.9
		41-50 years old	132	33.7
		≥51 years old	30	7.6
	Education level	College or below	73	18.6
		Bachelor's degree	190	48.5
		Master's degree	110	28.1
		Doctoral degree or above	19	4.8
	Position	Chairman / CEO	128	32.7
		Senior executives	143	36.5
		Department managers	121	30.8
Firm characteristics	Industry	Electronic information	121	30.9
		High-end equipment manufacturing	98	25.0
		New materials	83	21.2
		Biomedicine	61	15.6
		Other high-tech industries	29	7.3
	Firm size (employees)	≤50	96	24.5
		51-100	137	34.9
		101-300	111	28.3
		≥301	48	12.3

Reliability and validity of the measurement model

Prior to conducting the structural model analysis, the reliability and validity of the measurement model were systematically examined to ensure adequate measurement quality and analytical suitability of the questionnaire data. Based on 392 valid observations, the measurement model was assessed using SmartPLS. Before model estimation, tests of sampling adequacy were performed. As shown in Table 5, the results indicate that the overall Kaiser-Meyer-Olkin (KMO) value

reached 0.83, and Bartlett's test of sphericity was statistically significant, confirming that the data were suitable for latent variable analysis and subsequent structural modelling.

Further reliability assessments (see Table 6) reveal that Cronbach's alpha coefficients for all latent variables range from 0.782 to 0.911, exceeding the recommended threshold of 0.700. Composite reliability values range from 0.845 to 0.934, indicating satisfactory internal consistency and measurement stability at the construct level. With respect to validity assessment, both convergent and discriminant validity were comprehensively evaluated. The results show that the average variance extracted (AVE) for each latent variable ranges from 0.561 to 0.789, surpassing the recommended threshold of 0.500, thereby demonstrating adequate convergent validity.

Discriminant validity was further examined using both the heterotrait-monotrait ratio (HTMT) and the Fornell-Larcker criterion (see Table 7, Table 8). All HTMT values are below 0.850, and the square roots of the AVE for each construct exceed their correlations with other constructs, indicating no evidence of construct overlap. Overall, the measurement model demonstrates satisfactory data adequacy, reliability, and both convergent and discriminant validity, providing a solid foundation for subsequent structural model estimation and mediation effect analysis.

At the indicator level (see Table 9), all measurement items exhibit statistically significant standardised factor loadings, with the majority exceeding 0.700 and the lowest loading at 0.708. In addition, variance inflation factor (VIF) values for all indicators are below 3.000, suggesting that multicollinearity is not a concern and that the indicators are able to reflect their corresponding latent constructs with sufficient independence.

Table 5. Sampling adequacy test.

Test	Value
Kaiser-Meyer-Olkin (KMO) measure	0.83
Bartlett's test of sphericity	Significant ($p<0.001$)

Table 6. Reliability and convergent validity of constructs (N = 392).

Construct	Items	Cronbach's α	Composite reliability	AVE
Technological innovation capability	5	0.891	0.921	0.681
Absorptive capacity	5	0.911	0.934	0.789
Policy support intensity	5	0.782	0.845	0.561
Managerial international experience	5	0.824	0.873	0.632
Transnational network capability	5	0.867	0.904	0.653
International competitive advantage	5	0.856	0.901	0.694
Degree of internationalisation	5	0.839	0.889	0.668

Table 7. Discriminant validity assessment using Fornell-Larcker Criterion.

Construct	TIC	ACAP	PSI	MIE	TNC	ICA	DOI
TIC	0.820	/	/	/	/	/	/
ACAP	0.468	0.888	/	/	/	/	/
PSI	0.312	0.295	0.749	/	/	/	/
MIE	0.384	0.421	0.336	0.786	/	/	/
TNC	0.459	0.503	0.318	0.472	0.807	/	/
ICA	0.527	0.589	0.354	0.491	0.561	0.837	/
DOI	0.483	0.521	0.367	0.456	0.518	0.602	0.818

Table 8. Heterotrait-Monotrait Ratio (HTMT).

Construct pair	HTMT value
TIC - ACAP	0.624
TIC - PSI	0.418
TIC - MIE	0.509
TIC - TNC	0.601
TIC - ICA	0.682
TIC - DOI	0.645
ACAP - PSI	0.397
ACAP - MIE	0.556
ACAP - TNC	0.637
ACAP - ICA	0.712
ACAP - DOI	0.689
PSI - MIE	0.421
PSI - TNC	0.406
PSI - ICA	0.459
PSI - DOI	0.438
MIE - TNC	0.583
MIE - ICA	0.631
MIE - DOI	0.604
TNC - ICA	0.698
TNC - DOI	0.672
ICA - DOI	0.741

Table 9. Item loadings and collinearity diagnostics.

Construct	Item	Standardised loading	VIF
TIC	TIC1	0.812	1.74
	TIC2	0.846	1.89
	TIC3	0.781	1.63
	TIC4	0.708	1.52
	TIC5	0.792	1.68
ACAP	AC1	0.854	2.11
	AC2	0.883	2.24
	AC3	0.901	2.36
	AC4	0.876	2.18
	AC5	0.862	2.05
PSI	PSI1	0.742	1.41
	PSI2	0.768	1.53
	PSI3	0.721	1.47
	PSI4	0.735	1.44
	PSI5	0.756	1.50
MIE	MIE1	0.796	1.58
	MIE2	0.823	1.66
MIE	MIE3	0.781	1.61
	MIE4	0.807	1.63
	MIE5	0.789	1.59

Construct	Item	Standardised loading	VIF
TNC	TNC1	0.804	1.72
	TNC2	0.837	1.85
	TNC3	0.812	1.79
	TNC4	0.826	1.81
	TNC5	0.798	1.75
ICA	ICA1	0.861	2.03
	ICA2	0.884	2.15
	ICA3	0.823	1.98
	ICA4	0.842	2.06
	ICA5	0.856	2.10
DOI	DOI1	0.827	1.91
	DOI2	0.851	2.02
	DOI3	0.806	1.87
	DOI4	0.832	1.95
	DOI5	0.819	1.90

Structural model assessment and hypothesis testing

Following confirmation that the measurement model meets reliability and validity criteria, potential common method bias was mitigated via procedural controls and statistical tests. The structural model was then systematically assessed to examine path relationships among firm capabilities, international competitive advantage, and the degree of internationalisation. This assessment focused on the overall directional and associative links across these core constructs. The structural model estimation is based on 392 valid observations and was conducted using SmartPLS, with the significance and confidence intervals of path coefficients assessed through 5,000 bootstrap resamples. The results indicate that the model explains 57% of the variance in the mediating variable, international competitive advantage, and 61% of the variance in the core dependent variable, the degree of internationalisation. These explanatory power levels suggest that the proposed structural model possesses strong explanatory capacity and is able to adequately capture the mechanisms underlying internationalisation outcomes among high-tech SMEs in Langfang.

An examination of the structural path estimates reveals that, after incorporating international competitive advantage as a mediating variable, all firm capability variables continue to exert significant positive effects on the degree of internationalisation.

As shown in Table 10, the path coefficient from technological innovation capability to the degree of internationalisation is 0.231 ($p<0.001$), that from absorptive capacity is 0.214 ($p<0.001$), that from policy support intensity is 0.129 ($p<0.01$), that from managerial international experience is 0.158 ($p<0.01$), and that from transnational network capability is 0.191 ($p<0.001$), all of which are statistically significant. These findings indicate that firm capabilities not only exert their influence through mediating mechanisms but also retain a certain degree of direct effect on the internationalisation process. At the same time, the path coefficients from all capability variables to international competitive advantage are also significant.

Table 10. Direct effects on degree of internationalisation (DOI).

Structural path	β	t-value	p-value	95% CI
TIC - DOI	0.231	4.87	<0.001	[0.143, 0.312]
AC - DOI	0.214	4.52	<0.001	[0.126, 0.298]
PSI - DOI	0.129	2.63	0.009	[0.041, 0.215]
MIE - DOI	0.158	3.11	0.002	[0.066, 0.246]
TNC - DOI	0.191	3.98	<0.001	[0.102, 0.275]

At the same time, the path coefficients from all capability variables to international competitive advantage are also significant. Among them as Table 11, technological innovation capability (β=0.304, p<0.001) and absorptive capacity (β=0.279, p<0.001) exhibit relatively stronger effects, highlighting their central role in the formation of international competitive advantage, while policy support intensity, managerial international experience, and transnational network capability likewise contribute positively to the development of competitive advantage.

Table 11. Effects of IVs on international competitive advantage (ICA).

Structural path	β	t-value	p-value	95% CI
TIC - ICA	0.304	6.21	<0.001	[0.215, 0.381]
AC - ICA	0.279	5.73	<0.001	[0.192, 0.356]
PSI - ICA	0.168	3.41	0.001	[0.072, 0.253]
MIE - ICA	0.183	3.79	<0.001	[0.091, 0.269]
TNC - ICA	0.201	4.12	<0.001	[0.113, 0.289]

Building on the verification of significant direct effects, the mediating effects of international competitive advantage were further examined in this study. As shown in Table 12, Bootstrap resampling results show that the indirect effects of all firm capability variables on the degree of internationalisation through international competitive advantage are statistically significant, with their 95% confidence intervals (CI) excluding zero, indicating robust and credible mediation effects.

Table 12. Indirect effects via ICA (Bootstrapping = 5,000).

Indirect path	β	t-value	p-value	95% CI	Mediation
TIC - ICA - DOI	0.118	4.36	<0.001	[0.071, 0.173]	Partial
AC - ICA - DOI	0.108	4.02	<0.001	[0.062, 0.161]	Partial
PSI - ICA - DOI	0.065	2.91	0.004	[0.028, 0.114]	Strong
MIE - ICA - DOI	0.071	3.12	0.002	[0.034, 0.126]	Strong
TNC - ICA - DOI	0.078	3.38	0.001	[0.041, 0.138]	Strong

A comparison of direct and indirect effects reveals that technological innovation capability and absorptive capacity exhibit both significant direct and indirect effects on internationalisation (see Table 13), suggesting partial mediation. In contrast, for policy support intensity, managerial international experience, and transnational network capability, the mediating role of international competitive advantage is relatively more pronounced. Additionally, the structural model demonstrates satisfactory explanatory power (see Table 14): The R^2 value for international competitive advantage (ICA) reaches 0.57, while the R^2 for the degree of internationalisation (DOI) is 0.61 (adjusted R^2=0.603), indicating that the model accounts for a substantial proportion of the variance in core endogenous variables. Overall, the empirical findings consistently demonstrate that international competitive advantage plays a stable and critical mediating role in the transformation of firm capabilities into internationalisation outcomes, thereby providing systematic empirical support for the proposed theoretical model and research hypotheses shown Table 15.

Table 13. Total effects on degree of internationalisation (DOI).

Predictor	Direct	Indirect	Total
TIC	0.231	0.118	0.349
AC	0.214	0.108	0.322
PSI	0.129	0.065	0.194
MIE	0.158	0.071	0.229
TNC	0.191	0.078	0.269

Table 14. Structural model explanatory power.

Endogenous variable	R^2	Adjusted R^2
ICA	0.57	0.564
DOI	0.61	0.603

Table 15. Hypotheses testing results.

Hypothesis	Relationship	β	t-value	p-value	95% CI	Result
H_1	TIC - DOI	0.231	4.87	<0.001	[0.143, 0.312]	Supported
H_2	AC - DOI	0.214	4.52	<0.001	[0.126, 0.298]	Supported
H_3	PSI - DOI	0.129	2.63	0.009	[0.041, 0.215]	Supported
H_4	MIE - DOI	0.158	3.11	0.002	[0.066, 0.246]	Supported
H_5	TNC - DOI	0.191	3.98	<0.001	[0.102, 0.275]	Supported
H_6	TIC - ICA - DOI	0.118	4.36	<0.001	[0.071, 0.173]	Supported (Partial)
H_7	AC - ICA - DOI	0.108	4.02	<0.001	[0.062, 0.161]	Supported (Partial)
H_8	PSI - ICA - DOI	0.065	2.91	0.004	[0.028, 0.114]	Supported (Strong)
H_9	MIE - ICA - DOI	0.071	3.12	0.002	[0.034, 0.126]	Supported (Strong)
H_{10}	TNC - ICA - DOI	0.078	3.38	0.001	[0.041, 0.138]	Supported (Strong)

Discussion

Main findings

Based on empirical evidence from 392 valid samples of high-tech small and medium-sized enterprises (SMEs) in Langfang, the results provide systematic and robust support for the proposed theoretical framework linking firm capabilities, international competitive advantage, and the degree of internationalisation.

Structural model estimation indicates that technological innovation capability, absorptive capacity, policy support intensity, managerial international experience, and trans-national network capability all exert significant positive effects on firms' degree of inter-nationalisation. All hypotheses pertaining to the direct effects are fully supported by the empirical results. These findings collectively confirm the direct positive associations between the examined antecedent variables and firms' degree of internationalisation. This suggests that the internationalisation of high-tech SMEs in Langfang is not an incidental outcome, but rather the result of long-term accumulation and interaction of multiple capabilities.

Among these factors, technological innovation capability and absorptive capacity exhibit relatively stronger effects, underscoring that, in technology-intensive industries, firms' control over knowledge creation, absorption, and recombination remains the fundamental basis for international expansion.

After introducing international competitive advantage as a mediating variable, bootstrap mediation tests further reveal that all firm capabilities exert significant indirect effects on the degree of internationalisation through international competitive advantage, with confidence intervals that do not include zero, indicating strong robustness of the mediation mechanism. Specifically, technological innovation capability and absorptive capacity demonstrate characteristics of partial mediation, as both their direct and indirect effects are significant. This finding suggests that these capabilities not only directly promote internationalisation but also serve as core endogenous sources for the formation of international competitive advantage. In contrast, the effects of policy support intensity, managerial international experience, and transnational network capability on internationalisation are more strongly dependent on the mediating role of international competitive advantage, indicating that institutional resources, experiential capital, and relational networks must be "translated" into competitive advantage before they can effectively influence international market performance. Overall, the empirical results consistently demonstrate that international competitive advantage functions as a critical nexus in the transformation of firm capabilities into internationalisation outcomes. Firm capabilities do not automatically translate into

internationalisation performance; only when they are systematically integrated and externalised into recognisable and sustainable competitive advantages can high-tech SMEs achieve substantive internationalisation breakthroughs.

Research contributions

At the theoretical level, the core contribution of this study lies in its mechanism-based integration of Dynamic Capabilities Theory and the Uppsala model of internationalisation, and in its empirical identification of the key mediating pathway through which firm capabilities are transformed into internationalisation outcomes. In doing so, the study addresses a long-standing but insufficiently explained question in internationalisation research: Why firms may possess multiple capabilities yet fail to achieve corresponding internationalisation outcomes. While Dynamic Capabilities Theory emphasises the role of continuous resource integration and reconfiguration in generating competitive advantage, prior research has often remained at the level of a direct "capability-performance" relationship, with limited empirical examination of how capabilities are externalised into competitive advantages that are recognisable in international markets.

The findings of this study demonstrate that although technological innovation capability and absorptive capacity exert certain direct effects on internationalisation, their more critical role lies in shaping international competitive advantage. By contrast, policy support, managerial international experience, and transnational network capability do not automatically translate into internationalisation outcomes, but must operate through the mediating mechanism of competitive advantage to exert substantive effects. This evidence empirically confirms that dynamic capabilities are not direct sources of performance, but instead influence internationalisation outcomes indirectly through competitive advantage structures, thereby refining and extending the explanatory boundaries of Dynamic Capabilities Theory in the context of SME internationalisation.

At the same time, the study contributes to the Uppsala model by offering further refinement and extension. The results indicate that improvements in firm capabilities do not immediately manifest as sharp increases in the degree of internationalisation. Rather, they are first reflected in the formation and stabilisation of competitive advantage, which subsequently drives firms to gradually increase resource commitment and market engagement in internationalisation processes. The transmission pathway in this study follows a progressive sequence: from firm capabilities to international competitive advantage, and then to the degree of internationalisation. This sequential mechanism is highly consistent with the Uppsala model's core tenets regarding knowledge accumulation and evolving risk perceptions. It further underscores the endogenous driving role of firm capabilities throughout the entire internationalisation process. By linking the two theoretical perspectives at the critical juncture of competitive advantage formation, this study provides a more explanatory and empirically testable analytical framework for understanding the internationalisation mechanisms of high-tech SMEs, and offers a novel path for theoretical integration in regional internationalisation research.

From an industry and practical perspective, the value of this study lies in clarifying where internationalisation efforts should begin and in translating capability development into an actionable sequence of managerial decisions. The findings suggest that firms seeking international expansion must first transform internal capabilities into competitive advantages that are recognisable, credible, and valued by international buyers, distributors, and partners. Managers are advised to avoid conflating internationalisation with tactical activities (e.g., overseas exhibition participation, foreign agent appointment, cross-border e-commerce platform launch). Without underpinning international competitive advantage, such actions typically yield only short-term visibility while incurring long-term costs. This distinction underscores the need to align surface-level internationalisation efforts with deep-seated firm capabilities. A more effective internationalisation pathway begins with leveraging technological innovation and absorptive capacities to build verifiable product and process superiority. This superiority is then consolidated into tangible competitive advantage signals, including standards, patents, quality systems, delivery reliability, and cost control.

Finally, transnational networks and managerial international experience are deployed to accelerate the diffusion of these advantages and enhance market-

matching efficiency. For governments and industrial service institutions, the policy implication is equally pragmatic: The key question is not how much support to provide, but whether policy instruments can guide firms towards the critical stages of competitive advantage formation. This support framework encompasses international certification and compliance system development, as well as facilitation of participation in international standards and global supply chains. It also involves establishing overseas technology validation platforms and market access service systems to lower entry barriers for firms. Additionally, it prioritises the promotion of collaborative innovation initiatives and order-matching mechanisms with industry-leading enterprises. In this sense, this study proposes a "competitive advantage first, market expansion second" logic for the internationalisation of high-tech SMEs. It provides governments with clearer policy leverage points for firm capability upgrading, as well as industrial parks and intermediary platforms with more targeted service orientations. This dual guidance ultimately improves the conversion efficiency of internationalisation investments and reduces costly trial-and-error processes for Langfang's high-tech SMEs.

Conclusions

This study constructs a comprehensive analytical framework grounded in Dynamic Capabilities Theory and the Uppsala model of internationalisation. It systematically elucidates the mediating mechanism through which firm capabilities translate into internationalisation outcomes for high-tech SMEs in Langfang. Despite these contributions, the study has several limitations that merit discussion and point to avenues for future research.

First, at the level of research design, the study relies on cross-sectional survey data to examine the relationships among firm capabilities, international competitive advantage, and the degree of internationalisation. While this approach is effective in identifying structural associations among variables, it is limited in its ability to capture the dynamic evolution of capability accumulation, competitive advantage formation, and internationalisation progression over time. Both Dynamic Capabilities Theory and the Uppsala model emphasise the temporal dimension of capability reconfiguration and internationalisation trajectories, whereas cross-sectional data inherently reflect static outcomes at a single point in time. Future research could incorporate longitudinal data, tracking surveys, or event history analysis to provide a more nuanced depiction of the staged internationalisation process and to further elucidate the temporal dynamics of capability transformation mechanisms.

Second, in terms of variable measurement and data sources, this study primarily relies on self-reported questionnaire data from middle-level and senior-level managers. Although procedural remedies (such as anonymous responses and randomised item presentation) and statistical tests were employed to mitigate common method bias, subjective perceptual bias cannot be eliminated. This concern is particularly relevant for the measurement of international competitive advantage and the degree of internationalisation, as managerial assessments of relative positioning and international performance may be influenced by individual experience, information asymmetry, or contextual perceptions. Future studies can enhance the robustness of findings by incorporating more objective indicators, including export volumes, number of overseas markets, international patents, and international certifications. Triangulating primary survey data with secondary databases or official statistics can further strengthen the credibility of empirical results.

Third, regarding research context and sample scope, this study focuses on high-tech SMEs in Langfang, emphasising their representativeness and relevance within the Beijing-Tianjin-Hebei coordinated development framework. However, this regional focus inevitably constrains the generalisability of the findings. Regions exhibit significant differences in industrial structure, institutional environments, and the degree of international market embeddedness. Such cross-regional variations may induce heterogeneity in the pathways through which firm capabilities are translated into internationalisation outcomes. Future research could extend the analytical framework to other innovative cities or adopt cross-regional samples to conduct comparative analyses, thereby testing the applicability and boundary conditions of the proposed mechanisms across different institutional and industrial contexts.

Finally, with respect to theoretical model extension,

while this study confirms the critical mediating role of international competitive advantage between firm capabilities and internationalisation outcomes, it does not fully incorporate contextual factors such as environmental uncertainty, industry competition intensity, or digital capabilities that may influence the efficiency of capability transformation. Prior research suggests that environmental uncertainty and the pace of technological change can significantly alter how firm capabilities operate and the outcomes they generate. Future studies could introduce moderating variables or develop multi-level models to explore how the relationships among firm capabilities, competitive advantage, and internationalisation outcomes vary under different external environmental conditions, thereby advancing SME internationalisation research towards greater contextual sensitivity and explanatory depth.

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Conflicts of Interest

The authors declare no conflict of interest.

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