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Enhancing Growth in Chinese 'Little Giant' Enterprises: The Role of Open Innovation and Absorptive Capacity

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Abstract: Open innovation is crucial for Chinese 'Little Giant' enterprises as it addresses resource shortages and high innovation costs. However, there is limited research on the relationship between open innovation and enterprise growth performance, particularly for 'Little Giant' enterprises. This study adopts a quantitative approach, collecting data from 400 senior administrators in Chinese 'Little Giant' enterprises using a 5-point Likert scale. Data were gathered via structured questionnaires and analyzed through descriptive analysis, reliability and validity analysis, correlation analysis, and regression analysis. Key findings indicate that inbound open innovation significantly enhances growth performance directly and through potential and realized absorptive capacities. Effective resource acquisition and integration foster competitive advantage, while organizational forgetting mediates this relationship, aiding in the absorption and application of new technologies and enhancing innovation and growth. This study contributes to the literature by integrating enterprise growth theory, innovation theory, and resource dependence theory, elucidating the critical roles of absorptive capacities and organizational forgetting in the relationship between open innovation and growth performance. However, the study is limited by its focus on 'Little Giant' enterprises in

China and reliance on self-reported data, which may introduce biases and limit generalizability. Future research should include more diverse samples from different industries and geographic contexts and incorporate longitudinal and qualitative methods to understand better the evolving dynamics and subjective experiences of firms engaged in open innovation practices.

Keywords: Open innovation; Absorptive capacity; Enterprise growth performance; Organizational forgetting; 'Little Giant' Enterprises

1. Introduction

Small and medium-sized enterprises (SMEs) are vital to China's economic and employment resilience, significantly contributing to overall financial and social development (Ma et al., 2023). By 2022, China had 52 million micro, small, and medium-sized enterprises, with small and medium-sized industrial enterprises accounting for 58% of total industrial revenue. SMEs drive technological advancements and introduce new business models (Ibarra et al., 2020). As the world moves towards a knowledge-based economy, countries strive to lead the scientific and industrial revolutions. Maintaining economic vitality, ensuring stable employment, and fostering innovation are crucial for China. SMEs, particularly 'Little Giant' enterprises, play a pivotal role in this effort (Varga, 2021). These enterprises are recognized for their innovation, high market share, and core technological capabilities. Since 2018, over 12,000 Little Giant enterprises have been identified, mainly in high-tech industries such as information technology, advanced equipment manufacturing, and biomedicine (Zhang & Liu, 2020). These enterprises hold over 200,000 invention patents and have strong cooperative relationships with large companies, positioning them as key drivers of China's high-quality development and economic stability.

The Chinese Ministry of Industry and Information Technology has emphasized the importance of cultivating 'Little Giant' enterprises, supporting their innovation capabilities to transform them into core competitive entities (Ministry of Industry and Information Technology, 2018). Open innovation is essential for these enterprises, promoting collaboration and external resource utilization to enhance corporate performance (Surya et al., 2021). China's rapid economic growth and globalization trends provide 'Little Giant' enterprises with opportunities for growth and innovation. Expanding market demand, international cooperation, and initiatives like the Belt and Road offer these enterprises broad development space (Rahman, 2022). Growth performance is a crucial indicator for 'Little Giant' enterprises, encompassing sustainability, dynamics, and comprehensiveness. It reflects both quantitative growth, such as increased revenue and market share, and qualitative improvements, such as enhanced innovation capacity and efficiency (Ma et al., 2023). Given the importance of open innovation in addressing resource shortages and high innovation costs, it is necessary to explore the impact of open innovation on the growth performance of the 'Little Giant' enterprise.

Current studies have discussed enterprise growth performance in terms of financial performance (Kiyabo & Isaga, 2020), scale expansion (Peng & Tao, 2022)), and sustainable development quality (Lu et al., 2020). These studies have primarily examined financial performance through metrics like annual operating income, return on investment, and profit growth rate. Scale expansion has been measured by market share growth and the increase in employee count, while sustainable development quality has been assessed through consumer

satisfaction (W. Kim et al., 2020). While these areas provide a solid foundation for understanding enterprise growth, research gaps exist, particularly in the limited studies on outbound open innovation and the lack of integrated research on both directions of openness. Additionally, while research on absorptive capacity often focuses on knowledge, there is a lack of clear definition for "technology absorptive capacity". Furthermore, organizational forgetting, mainly explored qualitatively in China, requires deeper investigation. Addressing these gaps is crucial for advancing the understanding of how enterprises can effectively manage innovation and growth in dynamic environments.

This study aims to bridge these gaps by analyzing the impact of open innovation on the growth performance of 'Little Giant' enterprises, exploring potential and realized absorptive capacities, and examining organizational forgetting's role in the knowledge absorption process, providing a comprehensive model to enhance innovation and growth.

2. Literature review and hypothesis development

2.1 Theoretical approach

Enterprise growth theory explains the factors necessary for a firm’s growth, emphasizing the role of labor division, resource management, and capabilities (Yang et al., 2022). The theory divides into endogenous growth, focusing on internal factors like labor division and capabilities, and exogenous growth, emphasizing external factors like policy and market dynamics. Modern research integrates both perspectives, highlighting cooperation and strategic behavior (Yongjie, 2023). This study explores a new growth model for 'Little Giant' enterprises, stressing the importance of technological innovation and intelligent technology, such as big data and cloud computing, for sustainable development and core competitiveness.

Innovation theory identifies innovation as a crucial driver of economic growth originating from the enterprise's power (Min et al., 2021). Firms can innovate by developing new products, adopting new methods, opening new markets, sourcing new materials, and forming new organizations (Edeh et al., 2020). The essence of innovation theory, or "creative destruction," integrates technology with the economy to spur growth, driven by the pursuit of profit and the need for continuous enterprise development.

Resource dependence theory asserts that organizations form cooperative relationships due to mutual resource dependencies (Citation) (Barney et al., 2021). It highlights the necessity of interacting with internal and external environments to acquire valuable and scarce resources, as no organization can be completely self-sufficient (Tunisini et al., 2023). The theory underscores that external resources, like internal ones, significantly promote R&D and competitive advantages (Ramayah et al., 2020).

2.2 Hypothesis development

Research on open innovation has expanded from management to disciplines such as economics, sociology, and political science, exploring areas like knowledge management, absorptive capacity, and innovation value chain reconstruction (Mirza et al., 2022). Various studies have examined the impact of openness on growth performance, such as Ahmed et al. (2022) analyzed innovation globalization and R&D investment. Additionally, studies on user participation, property rights transactions, and knowledge spillover highlight the diverse facets of open innovation (Ferreira et al., 2023; Liu & Tang, 2020). The relationship between

open innovation and growth performance is still debated, with some studies reporting positive impacts while others find negative or non-significant effects (Moretti & Biancardi, 2020). Inbound open innovation enhances innovation and product development, whereas outbound open innovation maintains a competitive advantage through knowledge sharing (Sisodiya et al., 2013). Consequently, this study posits the following hypothesis:

H1a: Inbound open innovation may have a positive impact on enterprise growth performance;

H1b: Outbound open innovation may have a positive impact on enterprise growth performance.

Initially, researchers discussed open innovation from the perspectives of "resource base" and "dynamic capability". Baia et al. (2020) argued that an enterprise's competitive advantage and growth are determined by its heterogeneous resources and capabilities. In the context of open innovation, enterprises can "perceive" and "seize" opportunities through innovation capabilities. Huber et al. (2020) explored open innovation from a resource-dependence perspective, highlighting the critical role of technology absorptive capacity. Potential absorptive capacity acts as a bridge connecting internal and external resources, enabling enterprises to discover and absorb relevant external opportunities, particularly when these resources relate to continuous innovation (Ballestar et al., 2022). The similarity between internal and external knowledge bases enhances this absorptive process. However, open innovation requires crossing enterprise boundaries, which can be impeded by factors like "non-motor frequency" and lack of internal support (Aagaard & Rezac, 2022). Successful open innovation necessitates integrating and transforming new knowledge into the enterprise's existing knowledge base (Lam et al., 2021), thereby enhancing realized absorptive capacity. Thus, this study proposes the following hypothesis:

H2a: Inbound open innovation may have a positive effect on the potential absorptive capacity;

H2b: Outbound open innovation may have a positive effect on potential absorptive capacity;

H2c: Inbound open innovation may have a positive effect on the realized absorptive capacity;

H2d: Outbound open innovation may have a positive effect on realized absorptive capacity.

Technology absorptive capacity refers to an enterprise's ability to introduce, digest, and absorb external technology and transform it into output (Wang & Sun, 2020). Enhancing this capacity in manufacturing enterprises requires an open development environment, unlike traditional closed development modes. Open environments allow access to external resources, with the degree of success depending on the implementation of service-oriented strategies (Sholihah et al., 2020). This study divides technology absorptive capacity into potential and realized absorptive capacity. Potential absorptive capacity involves acquiring and digesting external knowledge, enabling continuous updates to the enterprise's knowledge base, thus overcoming capability traps and organizational inertia (Hu et al., 2021). Realized absorptive capacity refers to transforming and using knowledge, integrating external insights with internal knowledge to optimize technology, processes, and products (Hu et al., 2021). Both capacities significantly enhance innovation and growth performance. For 'Little Giant'

enterprises, strong technology absorptive capacity allows them to overcome industry barriers, improve efficiency, achieve economies of scale, and enhance growth performance through open innovation. Therefore, the following hypotheses are proposed below:

H3a: Potential absorptive capacity may have a positive impact on enterprise growth performance;

H3b: Realized absorptive capacity may have a positive impact on enterprise growth performance.

Theories of technology absorptive capacity and open innovation are aligned in enhancing competitive advantage and market share (Aliasghar & Haar, 2023). Technology absorptive capacity is a dynamic, creative, and sustainable development capability that necessitates a comprehensive approach involving various enterprise departments (Dzhengiz & Niesten, 2020). Implementing an open innovation strategy influences overall technology absorptive capacity, fostering innovation and optimizing resource allocation (Carrasco-Carvajal et al., 2023).

Both inbound and outbound open innovation are closely linked to an enterprise's technology absorptive capacity. Outbound open innovation allows enterprises to gather external information and resources, improving communication efficiency and internal innovation. This influx of innovative resources can enhance growth capabilities through strong technology absorptive capacity (Mahmood & Mubarik, 2020). Frequent interactions with external entities promote technological collaboration, further boosting absorptive capacity and enterprise growth. Additionally, external cooperation pressures internal innovators to improve efficiency and resource utilization, strengthening technological absorption and growth capabilities.

Technology absorptive capacity is crucial for acquiring, digesting, transforming, and applying new technologies from external sources, enhancing an enterprise's ability to seize market opportunities. It directly impacts the relationship between open innovation and enterprise growth performance. Strong potential absorptive capacity enables enterprises to acquire and integrate external technical resources, reducing research and development risks and improving innovation efficiency (Duan et al., 2020). Realized absorptive capacity allows enterprises to transform and utilize knowledge, accelerating new product development and commercialization (Chaparro et al., 2021). Open innovation, by emphasizing the permeability of enterprise boundaries and integrating internal and external resources, reduces innovation costs and enhances growth performance. Therefore, this study proposes the following hypothesis:

H4a: Potential absorptive capacity may play a mediating role between inbound open innovation and enterprises' growth performance;

H4b: Potential absorptive capacity may mediate between outbound open innovation and enterprises' growth performance;

H4d: Realized absorptive capacity may mediate between inbound open innovation and enterprises' growth performance;

H4e: Realized absorptive capacity may play a mediating role in outbound open innovation and enterprises' growth performance.

Organizational forgetting, essential for developing technology absorptive capacity, involves actively discarding and passively omitting outdated knowledge to make room for

new insights (Wang et al., 2022). Absorptive capacity comprises knowledge acquisition, digestion, transformation, and utilization. Potential absorptive capacity covers acquisition and digestion, while realized absorptive capacity involves transformation and application. Enterprises utilize technological absorptive capacity to harness external information for commercial purposes, necessitating the removal of obsolete knowledge to facilitate new learning (Nanda et al., 2020).

In the context of inbound open innovation, potential absorptive capacity connects internal and external resources. Organizational forgetting helps discard detrimental habits and outdated logic (Klammer, 2021), thereby enhancing the acquisition and digestion of new technologies and knowledge. This process positively moderates the relationship between inbound open innovation and potential absorptive capacity. For outbound open innovation, organizational forgetting involves identifying and evaluating unused or misaligned resources, enabling the external commercialization of technological knowledge. By eliminating outdated knowledge, enterprises create space for new technologies, thereby fostering the transformation and utilization of new knowledge (Ben Arfi & Hikkerova, 2021). Consequently, organizational forgetting positively regulates the relationship between both inbound and outbound open innovation and absorptive capacities. Thus, this study posits the following hypothesis:

H5a: Organizational forgetting may positively regulate the effect of inbound open innovation on potential absorptive capacity;

H5b: Organizational forgetting may positively regulate the effect of outbound open innovation on potential absorptive capacity;

H5c: Organizational forgetting may positively regulate the effect of inbound open innovation on realized absorptive capacity;

H5d: Organizational forgetting may positively regulate the effect of outbound open innovation on realized absorptive capacity.

3. Methodology

Adopting a quantitative approach, this study gathered data through a structured questionnaire. Limiting the senior managers of 'Little Giant' enterprises that are in the list nurtured and published by China's Ministry of Industry and Information Technology since 2018, as the participants, this study distributed 420 questionnaires randomly through E-Mail, and 400 were viewed as available. Statistical analysis includes descriptive analysis, reliability and validity analysis, correlation analysis, and regression analysis.

The study implements a series of systematically organized questionnaires, each meticulously formulated to accurately assess essential variables utilizing a 5-point Likert scale:

Enterprise growth performance measures business growth through indicators like revenue growth, employee count, market share, and profit growth. This study, incorporating Hansen et al. (2009) and Li et al. (2023), measures growth using six items: revenue growth, ROI increase, market share growth, profit growth, employee growth, and product/service satisfaction.

Open innovation, involving knowledge flow, is divided into inbound and outbound open innovation. This study integrates research from Huizingh (2011), West and Bogers (2014),

and West and Bogers (2017), tailored to Chinese 'Little Giant' enterprises. Inbound open innovation is measured by five items, and outbound open innovation by four items. Thus, this study will use the same scale.

Technology absorptive capacity is divided into potential and realized absorptive capacity (Mahmood & Mubarik, 2020). This study integrates the work of Kneller (2005), and Qi et al. (2021), tailored to 'Little Giant' enterprises. The scale for measuring absorptive capacity includes eight items each for potential and realized absorptive capacity, incorporating necessary modifications to fit the specific research context.

Organizational forgetting refers to the process by which organizations lose previously acquired knowledge. This study integrates research from Mariano et al. (2020), Ayduğ and Ağaoğlu (2023), and Bongso (2020). Tailored to the research purpose, needs, and context of 'Little Giant' enterprises, ten items were selected and modified to measure the current state of organizational forgetting.

4. Results

4.1 Descriptive analysis

Table 1 provides a comprehensive analysis of the basic demographic characteristics of the respondents, categorized by gender, age, and length of service within the organization. This detailed breakdown offers insights into the distribution and cumulative percentages of each category.

The sample comprises 206 males, representing 51.5% of the respondents, and 194 females, constituting 48.5%. The cumulative percentage reaches 100.0%, indicating a near-equal representation of both genders. This balanced gender distribution ensures that the perspectives of both male and female respondents are adequately represented in the study.

The respondents are segmented into five age groups: 27 respondents (6.8%) are aged 18-25, 111 respondents (27.8%) are aged 26-35, 102 respondents (25.5%) are aged 36-45, 125 respondents (31.3%) are aged 46-55, and 35 respondents (8.8%) are aged 56 or older. This distribution indicates a balanced age representation, with the majority (84.6%) falling within the 26-55 age range, suggesting a workforce primarily in their most productive years, offering a mix of youthful energy and experienced insight.

The respondents' length of service is categorized as follows: 70 respondents (17.5%) have been with the organization for under 5 years, 116 respondents (29.0%) for 6-10 years, 68 respondents (17.0%) for 11-15 years, 72 respondents (18.0%) for 16-20 years, and 74 respondents (18.5%) for over 20 years. This diverse range of service lengths indicates a workforce with a mix of fresh perspectives and seasoned expertise, with a notable portion (36.5%) having served over 15 years, reflecting substantial organizational experience.

In summary, Table 1 provides a detailed overview of the respondents' demographics, showing a balanced gender distribution, a predominant age range of 26-55 years, and a wide span of service lengths. This diversity contributes to the robustness of the study's findings, ensuring a comprehensive understanding of the population under study.

Table 1 Distribution of respondents' basic situation

Name	Options	Frequency □	Percentage (%)□	Cumulative percentage (%)□
Gender	male	206	51.5	51.5
	female	194	48.5	100.0
Age	Ages 18-25	27	6.8	6.8
	Ages 26-35	111	27.8	34.5
	Ages 36-45	102	25.5	60.0
	46-55 years old	125	31.3	91.3
	Age 56 or older	35	8.8	100.0
Length of service	Under 5 years	70	17.5	17.5
	6-10 years	116	29.0	46.5
	11-15 years	68	17.0	63.5
	16-20 years	72	18.0	81.5
	20 + years	74	18.5	100.0

4.2 Reliability and validity analysis

As shown in Table 2, the Cronbach's alpha values for the six growth performance items range from 0.898 to 0.928, all exceeding 0.8, which indicates high reliability of the research data. The corrected item-total correlation (CITC) values for all items are greater than 0.5, demonstrating a good correlation between the items. Consequently, the scale reliability of growth performance is high and meets the study's requirements.

Table 2 Reliability analysis results of growth performance

Variables	Item	CITC □	Delete Cronbach 'α after the question item	Cronbach alpha. '
Growth performance	GP1	725.	925.	0.929
	GP2	701.	928.	
	GP3	747.	923.	
	GP4	791.	917.	
	GP5	903.	905.	
	GP6	932.	898.	

Table 3 presents Cronbach's alpha values for the five items measuring inbound innovation range from 0.853 to 0.872, all exceeding 0.7, and the corrected item-total correlation (CITC) values for all items are greater than 0.5. Similarly, Cronbach's alpha values for the four items measuring outbound innovation range from 0.731 to 0.814, also

exceeding 0.7, with CITC values greater than 0.5 for all items. Therefore, the scale reliability for both dimensions of open innovation is high, meeting the research requirements.

Table 3 Results of open innovation reliability analysis

Variables	Dimensions	item	CITC □	Delete Cronbach 'α after the question item	Cronbach alpha. '
Open innovation	Inbound open innovation	EDOI1	730.	863.	0.888
		EDOI2	690.	872.	
		EDOI3	770.	853.	
		EDOI4	718.	865.	
		EDOI5	729.	863.	
	Outbound open innovation	EGOI1	548.	814.	0.818
		EGOI2	655.	764.	
		EGOI3	638.	772.	
		EGOI4	721.	731.	

Table 4 presents the Cronbach's alpha values for the eight items measuring potential absorptive capacity range from 0.916 to 0.937, with all corrected item-total correlation (CITC) values exceeding 0.5. Similarly, the Cronbach's alpha values for the eight items measuring realized absorptive capacity range from 0.866 to 0.892, with all CITC values also exceeding 0.5. These results indicate that the scale reliability for each dimension of technology absorptive capacity is high and meets the research requirements.

Table 4 Reliability analysis results of technology absorptive capacity

Variables	Dimensions	Item	CITC □	Delete Cronbach 'α after the question item	Cronbach alpha. '
Technology absorptive capacity	Potential absorptive capacity	PAC1	773.	924.	0.933
		PAC2	798.	922.	
		PAC3	861.	918.	
		PAC4	665.	932.	
		PAC5	727.	928.	
		PAC6	606.	937.	
		PAC7	890.	916.	

		PAC8	879.	918.	
		RAC1	854.	866.	
		RAC2	779.	874.	
		RAC3	813.	870.	
	Realized absorptive capacity	RAC4	592.	892.	0.897
		RAC5	589.	891.	
		RAC6	600.	891.	
		RAC7	584.	892.	
		RAC8	611.	890.	

Table 5 presents the Cronbach's alpha values for the ten items measuring organizational forgetting range from 0.924 to 0.932, all exceeding 0.7. Additionally, the corrected item-total correlation (CITC) values for all items are greater than 0.5. These results indicate that the scale reliability for organizational forgetting is high and meets the research requirements.

Table 5 Results of reliability analysis of organizational forgetting

Variables	**Item**	**CITC**	**Cronbach 'α after deleting the question item**	**Cronbach alpha. '**
	OF1	849.	924.	
	OF2	820.	926.	
	OF3	721.	931.	
	OF4	689.	932.	
Organizational forgetting	OF5	698.	932.	0.936
	OF6	695.	932.	
	OF7	758.	929.	
	OF8	722.	930.	
	OF9	738.	930.	
	OF10	746.	929.	

Table 6 shows the significance level of the Bartlett sphericity test for growth performance variables is less than 0.001; the approximate chi-square is 2429.168, the degree of freedom is 15, and the KMO sampling fitness test statistics are 0.705. This indicates a high degree of information overlap and correlation among the questionnaire items.

Table 6 KMO measure of growth performance and Bartlett spheroid test results

KMO	**705.**

KMO		**705.**
Bartlett sphericity test	Approximate Chi-square	2429.168
	Degrees of Freedom	15
	Salience	000.

Table 7 shows the significance level of the Bartlett spherical test for growth performance variables is less than 0.001; the approximate chi-square is 1837.343, the degree of freedom is 36, and the KMO sampling fitness test statistics are 0.866. This indicates a high degree of information overlap and correlation among the questionnaire items.

Table 7 KMO measure and Bartlett sphere test results of open innovation

KMO		866.
Bartlett sphericity test	Approximate Chi-square	1837.343
	Degrees of Freedom	36
	Salience	000.

Table 8 presents the significance level of the Bartlett sphericity test for growth performance variables is less than 0.001, the approximate chi-square is 5333.953, the degree of freedom is 120, and the KMO sampling fitness test statistics are 0.806. This indicates a high degree of information overlap and correlation among the questionnaire items.

Table 8 KMO measure of technology absorptive capacity and Bartlett sphere test results

KMO		806.
Bartlett sphericity test	Approximate chi-square	5333.953
	Degrees of Freedom	120

Table 9 shows, the significance level of the Bartlett sphericity test for growth performance variables is less than 0.001; the approximate chi-square is 225.956, the degree of freedom is 45, and the KMO sampling fitness test statistics are 0.890. This indicates a high degree of information overlap and correlation among the questionnaire items.

Table 9 KMO measure of organizational forgetting and Bartlett spheroid test results

KMO		890.
Bartlett sphericity test	Approximate Chi-square	225.956
	Degrees of Freedom	45
	significance	000.

4.3 Correlation analysis

Table 10 presents the Pearson correlation analysis, illustrating the relationships among various organizational variables: length of service, number of employees, annual operating income, nature of the company, type of business, growth performance, inbound and outbound innovation, potential and realized absorptive capacity, and organizational forgetting.

In terms of descriptive statistics, the length of service has a mean of 3.0950 and a standard deviation of 93.978, while the number of employees has a mean of 2.4300 and a standard deviation of 85.553. Annual operating income shows a mean of 2.5400 with a

standard deviation of 83.974. The nature of the company has a mean of 2.5800 and a standard deviation of 1.14537, and the type of business has a mean of 2.9250 with a standard deviation of 1.92188. Other variables, including growth performance, inbound and outbound innovation, potential and realized absorptive capacity, and organizational forgetting, also have their respective means and standard deviations listed.

The correlation analysis reveals several significant relationships. Growth performance is positively correlated with inbound innovation ($r = 0.365$, $p < 0.01$) and outbound innovation ($r = 0.357$, $p < 0.01$), indicating that firms with higher growth performance tend to engage more in both inbound and outbound innovation activities. Inbound innovation is also positively correlated with outbound innovation ($r = 0.563$, $p < 0.01$) and potential absorptive capacity ($r = 0.284$, $p < 0.01$), suggesting that companies active in inbound innovation also excel in outbound innovation and have a higher capacity to absorb new knowledge.

Furthermore, realized absorptive capacity is positively correlated with organizational forgetting ($r = 0.230$, $p < 0.01$), highlighting a relationship between the ability to utilize absorbed knowledge and the process of organizational forgetting. These findings underscore the complex and interconnected nature of organizational dynamics, particularly regarding innovation activities and absorptive capacities.

Overall, the table suggests significant interrelationships among these variables, emphasizing the importance of understanding how different aspects of organizational behavior and capabilities influence each other. This insight is crucial for developing strategies to enhance organizational performance and innovation.

Table 10 Pearson correlation

	Averages	**Standard deviation**	**Length of service**	**Number of employees**	**Annual operating income**	**Nature of company**	**Type of Business**	**Growth Performance**	**Inbound**	**Outbound**	**Potential absorbency**	**Realized absorptive capacity**	**Organizational Forgetting**
Length of service	3.0950	93978.	1										
Number of employees	2.4300	85553.	-032.	1									
Annual operating income	2.5400	83974.	-040.	-024.	1								
Nature of	2.5800	1.1453	-054	088.	-035.	1							

company		7	.										
Type of business	2.9250	1.92188	001.	087.	- 004.	-012.	1						
Growth performance	2.2054	83544.	048.	- 033.	031.	-024.	017.	1					
Inbound	3.0540	1.02573	076.	034.	041.	-011.	-025.	365.	1				
Outbound	2.9656	84880.	048.	- 049.	- 029.	-026.	006.	357.	563.	1			
Potential absorptive capacity	2.5081	97643.	017.	- 023.	- 031.	011.	036.	364.	284.	344.	1		
Realized absorptive capacity	2.4863	90020.	-011.	062.	017.	051.	-037.	252.	215.	235.	180.	1	
Organizational forgetting	2.6948	1.01668	018.	- 027.	- 020.	-004.	-043.	203.	005.	130.	318.	230.	1

* p<0.05 ** p<0.01

4.4 Regression analysis

4.4.1 Direct effect analysis

Table 11 presents the results of hierarchical regression analysis examining the impact of open innovation on enterprise growth performance. Model 1 includes control variables (gender, age, company age, length of service, number of employees, annual operating income, nature of the company, and type of business) and shows no significant effect ($R^2 = 0.007$, $F = 0.341$, $p = 0.950$). Model 2 adds inbound open innovation, which significantly predicts growth performance ($\beta = 0.366$, $p < 0.001$, $R^2 = 0.139$, $\Delta R^2 = 0.132$, $F = 6.995$, $p < 0.001$). Model 3 includes both inbound and outbound open innovation, with both significantly contributing to growth performance (inbound $\beta = 0.241$, $p < 0.001$; outbound $\beta = 0.219$, $p < 0.001$, $R^2 = 0.171$, $\Delta R^2 = 0.171$, $F = 8.032$, $p < 0.001$). The results indicate that open innovation, particularly inbound and outbound, significantly enhances enterprise growth performance. Therefore, H1a and H1b are assumed to pass the verification.

Table 11 Results of hierarchical regression analysis of open innovation and enterprise growth performance

	Model 1	Model 2	Model 3
Constant	1.972 * * *	* *4.018	* * 2.746
	(6.748)	(1.187)	(0.825)
Gender	0.042	0.038	0.027
	(0.830)	(0.798)	(0.590)
Age	0.012	0.029	0.018
	(0.198)	(0.508)	(0.328)
Company age	0.049	0.027	0.033
	(0.802)	(0.466)	(0.594)
Length of service	0.013	0.034	0.039
	(0.191)	(0.537)	(0.623)
Number of employees	0.033	0.046	0.030
	(0.637)	(0.959)	(0.634)
Annual operating income	0.30	0.012	0.025
	(0.582)	(0.532)	(0.531)
Nature of company	0.017	0.014	0.010
	(0.344)	(0.299)	(0.220)
Type of business	0.019	0.029	0.024
	(0.366)	(0.618)	(0.517)
Inbound open innovation		0.366 * * *	0.241 * * *
		(7.734)	(4.272)
Outbound open innovation			0.219 * * *
			(3.884)
Sample size	400	400	400
R2	0.007	0.139	0.171
Adjust R2	0.013	0.119	0.150
F number □	F = 0.341, p = 0.950	F =6.995, p<0.001	F =8.032, p<0.001

	Model 1	Model 2	Model 3
△R2	0.007	0.132	0.171
△F value □	F =0.341, p=0.950	F =59.817, p<0.001	F =15.088, p<0.001
Dependent variable: Growth Performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 12 presents the results of hierarchical regression analysis examining the impact of open innovation on potential absorptive capacity (PAC). Model 1 includes control variables (gender, age, company age, length of service, number of employees, annual operating income, nature of the company, and type of business) and shows no significant effect ($R^2 = 0.007$, $F = 0.321$, $p = 0.958$). Model 2 adds inbound open innovation, which significantly predicts PAC ($\beta = 0.288$, $p < 0.001$, $R^2 = 0.089$, $\Delta R^2 = 0.082$, $F = 4.218$, $p < 0.001$). Model 3 includes both inbound and outbound open innovation, with both significantly contributing to PAC (inbound $\beta = 0.136$, $p < 0.001$; outbound $\beta = 0.269$, $p < 0.001$, $R^2 = 0.137$, $\Delta R^2 = 0.048$, $F = 6.183$, $p < 0.001$). These results indicate that open innovation, particularly inbound and outbound, significantly enhances a firm's potential absorptive capacity.

Table 13 presents the results of hierarchical regression analysis examining the impact of open innovation on realized absorptive capacity (RAC). Model 1 includes control variables (gender, age, company age, length of service, number of employees, annual operating income, nature of the company, and type of business) and shows no significant effect ($R^2 = 0.016$, $F = 0.785$, $p = 0.616$). Model 2 adds inbound open innovation, which significantly predicts RAC ($\beta = 0.211$, $p < 0.001$, $R^2 = 0.060$, $\Delta R^2 = 0.044$, $F = 2.763$, $p = 0.004$). Model 3 includes both inbound and outbound open innovation, with outbound open innovation significantly contributing to RAC (inbound $\beta = 0.109$, $p = 0.067$; outbound $\beta = 0.180$, $p < 0.01$, $R^2 = 0.082$, $\Delta R^2 = 0.022$, $F = 3.453$, $p < 0.001$). These results indicate that while inbound open innovation has a smaller, non-significant effect in the final model, outbound open innovation significantly enhances a firm's realized absorptive capacity.

Table 13 Results of hierarchical regression analysis of open innovation and realized absorptive capacity

	Model 1	Model 2	Model 3
Constant	2.395 * * *	1.906 * * *	1.586 * * *
	(7.641)	(5.822)	(4.656)
Gender	0.025	0.027	0.036
	(-0.494)	(-0.556)	(0.732)
Age	0.061	0.051	0.06
	(-1.005)	(-0.863)	(1.018)
Company age	0.047	0.06	0.054
	(-0.765)	(-0.998)	(0.914)
Length	0.112	0.1	0.096
of service	(1.642)	(1.492)	(1.447)
Number	of0.057	0.049	0.062
employees	(1.113)	(0.983)	(1.253)

	Model 1	Model 2	Model 3
Annual operating income	0.026 (0.522)	0.016 (0.328)	0.027 (0.544)
Nature of company	0.045 (0.884)	0.047 (0.942)	0.05 (1.018)
Type of business	0.042 (-0.83)	0.036 (0.723)	0.04 (-0.817)
Inbound open innovation		0.211 * * * (4.279)	0.109 (1.841)
Outbound open innovation			0.18 * * (3.023)
Sample size	400	400	400
R2	0.016	0.060	0.082
Adjust R2	0.004	0.038	0.058
F number □	F = 0.785, p = 0.616	F =2.763,p=0.004	F =3.453,p<0.001
△R2	0.016	0.044	0.022
△F value □	F =0.785,p=0.616	F =18.310,p<0.001	F =9.141,p=0.003
Dependent variable: realized absorptive capacity (RAC)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 14 presents the results of hierarchical regression analysis examining the impact of technology absorptive capacity on growth performance (GP). Model 1 includes control variables (gender, age, company age, length of service, number of employees, annual operating income, nature of the company, and type of business) and shows no significant effect ($R^2 = 0.007$, $F = 0.341$, $p = 0.950$). Model 2 adds potential absorptive capacity (PAR), which significantly predicts growth performance ($\beta = 0.365$, $p < 0.001$, $R^2 = 0.139$, $\Delta R^2 = 0.132$, $F = 7.001$, $p < 0.001$). Model 3 includes both potential and realized absorptive capacity (RAC), with both significantly contributing to growth performance (PAR $\beta = 0.328$, $p < 0.001$; RAC $\beta = 0.201$, $p < 0.001$, $R^2 = 0.177$, $\Delta R^2 = 0.038$, $F = 8.387$, $p < 0.001$). These results indicate that technology absorptive capacity, both potential and realized, significantly enhances a firm's growth performance.

Table 14 Results of hierarchical regression analysis of technology absorptive capacity and growth performance

	Model 1	Model 2	Model 3
Constant	1.972 * * * (6.748)	1.182 * * * (4.065)	0.817 * * (2.746)
Gender	0.042 (0.830)	0.031 (0.662)	0.037 (0.808)
Age	0.012 (0.198)	0.029 (0.52)	0.04 (0.719)
Company	0.049	0.037	0.047

	Model 1	Model 2	Model 3
age	(0.802)	(0.64)	(0.843)
Length of service	0.013 (0.191)	0.011 (0.173)	0.034 (0.538)
Number of employees	0.033 (0.637)	0.021 (0.445)	0.034 (0.722)
Annual operating income	0.30 (0.582)	0.04 (0.84)	0.033 (0.721)
Nature of company	0.017 (0.344)	0.023 (0.495)	0.032 (0.685)
Type of business	0.019 (0.366)	0.005 (0.098)	0.014 (0.312)
Potential absorptive capacity (PAR)		0.365 * * * (7.738)	0.328 * * * (6.977)
Realized absorptive capacity (RAC)			0.201 * * * (4.254)
Sample size	400	400	400
R^2	0.007	0.139	0.177
Adjust R	0.013	0.119	0.156
F number □	F = 0.341, p = 0.950	F =7.001, p<0.001	F =8.387, p<0.001
$\triangle R^2$	0.007	0.132	0.038
△F value □	F =0.341, p=0.950	F =59.872, p<0.001	F =18.096, p<0.001
Dependent variable: Growth performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

4.4.2 Mediation effect analysis

(1) The mediating effect of potential absorptive capacity

In analyzing the mediating effect of potential absorptive capacity (PAC) on the relationship between endogenous open innovation and enterprise growth performance, the standardized coefficient of endogenous open innovation in Model 2 is 0.366 ($p < 0.001$). However, in Model 3, the standardized coefficient of potential absorptive capacity is 0.284 ($p < 0.001$), which is lower than the coefficient in Model 2. This reduction indicates that potential absorptive capacity plays a partial mediating role in the relationship between endogenous open innovation and enterprise growth performance (see Table 15).

Table 15 Analysis of the mediating effect of potential absorptive capacity

	Model 1	Model 2	Model 3
Constant	1.972 * * * (6.748)	1.187 * * * (4.018)	0.749 * * (2.602)
Gender	0.042 (0.830)	0.038 (0.798)	0.03 (0.67)

	Model 1	Model 2	Model 3
Age	0.012	0.029	0.039
	(0.198)	(0.508)	(0.711)
Company age	0.049	0.027	0.022
	(0.802)	(0.466)	(0.4)
Length of service	0.013	0.034	0.028
	(0.191)	(0.537)	(-0.458)
Number of employees	0.033	0.046	0.034
	(0.637)	(0.959)	(-0.744)
Annual operating income	0.30	0.012	0.024
	(0.582)	(0.532)	(0.522)
Nature of company	0.017	0.014	0.02
	(0.344)	(0.299)	(-0.431)
Type of business	0.019	0.029	0.016
	(0.366)	(0.618)	(0.345)
inbound open innovation		0.366 * * *	0.284 * * *
		(7.734)	(6.005)
Mediating variable			
Potential absorptive capacity (PAC)			0.283 * * *
			(6.009)
Sample size	400	400	400
R^2	0.007	0.139	0.171
Adjust R	0.013	0.119	0.192
F number □	F = 0.341, p = 0.950	F =6.995, p<0.001	F =5.908, p<0.001
$\triangle R^2$	0.007	0.132	0.192
ΔF value □	F =0.341, p=0.950	F =59.817, p<0.001	F =36.114, p<0.001
Dependent variable: Growth performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 16 presents the results of Bootstrap analysis. The 95% confidence interval of the indirect effect is [0.0368; 0.0996], excluding 0. This indicates that potential absorptive capacity plays a partial mediating role between inbound open innovation and enterprise growth performance. Thus, hypothesis H4a, which posits that potential absorptive capacity mediates the relationship between inbound open innovation and enterprise growth performance, is partially supported.

Table 16 The mediating role of Potential absorptive capacity (PAC) Bootstrap analysis

	Effects	Effect	SE	95%CI LLCI	ULCI
The mediating role of potential absorptive capacity (PAC)	Indirect effect of X on Y: Indirect effect of X on Y	0656.	0163.	0368.	0996.

	Direct effect of X on Y Direct effect of X on Y	2313.	0380.	0000.	1567.
	Total effect of X on Y Total Effect of X on Y	2970.	0380.	0000.	2222.

Table 17 presents the analysis of the mediating effect of potential absorptive capacity on the relationship between outbound open innovation and enterprise growth performance. In Model 2, the standardized coefficient of outbound open innovation is 0.356 ($p < 0.001$). However, in Model 3, the standardized coefficient of potential absorptive capacity is 0.261 ($p < 0.001$), which is lower than the coefficient in Model 2. This indicates that potential absorptive capacity plays a partial mediating role in the relationship between outbound open innovation and enterprise growth performance .

Table 17 Analysis of mediating effect of potential absorptive capacity

	Model 1	Model 2	Model 3
Constant	1.972 * * *	0.95 * * *	0.628 * * *
	(6.748)	(3.109)	(2.096)
Gender	0.042	0.023	0.02
	(0.830)	(0.484)	(0.437)
Age	0.012	0.004	0.019
	(0.198)	(0.074)	(0.356)
Company age	0.049	0.048	0.039
	(0.802)	(0.832)	(0.699)
Length	0.013	0.033	0.026
of service	(0.191)	(-0.509)	(-0.42)
Number of employees	0.033	0.014	0.01
	(0.637)	(-0.292)	(-0.226)
Annual operating	0.30	0.041	0.045
income	(0.582)	(0.854)	(0.991)
Nature of company	0.017	0.009	0.016
	(0.344)	(-0.194)	(-0.348)
Type of business	0.019	0.016	0.006
	(0.366)	(0.338)	(0.136)
Outbound open innovation		0.356 * * *	0.261 * * *
		(7.505)	(5.364)
Mediating variables			
Potential absorptive capacity			0.275 * * *
(PAC)			(5.665)
Sample size	400	400	400
R^2	0.007	0.132	0.198
Adjust R	0.013	0.112	0.178
F number □	F = 0.341, p = 0.950	F =6.604,p<0.001	F =9.627,p<0.001
$\triangle R^2$	0.007	0.125	0.066
△F value □	F =0.341,p=0.950	F =56.321,p<0.001	F =32.094,p<0.001

	Model 1	Model 2	Model 3
Dependent variable: Growth performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 18 shows the results of the Bootstrap analysis, indicating that the 95% confidence interval for the indirect effect is [0.0531; 0.1408], excluding 0. This demonstrates that potential absorptive capacity (PAC) plays a partial mediating role between outbound open innovation and enterprise growth performance (GP). Therefore, hypothesis H4b, which posits that potential absorptive capacity mediates the relationship between outbound open innovation and enterprise growth performance, is partially supported.

Table 18 The mediating role of Potential absorptive capacity (PAC) Bootstrap analysis

	effect	Effect	SE	95%CI LLCI	ULCI
Potential absorptive capacity (mediating role of PAC)	Indirect effect of X on Y:	0928.	0227.	0531.	1408.
	Direct effect of X on Y	2589.	0472.	0000.	1661.
	Total effect of X on Y	3518.	0461.	0000.	2612.

(2) The mediating role of realized absorptive capacity

Table 19 presents the analysis of the mediating effect of realized absorptive capacity (RAC) on the relationship between endogenous open innovation and enterprise growth performance. In Model 2, the standardized coefficient of endogenous open innovation is 0.366 ($p < 0.001$). However, in Model 3, the standardized coefficient of realized absorptive capacity is 0.325 ($p < 0.001$), which is lower than the coefficient in Model 2. This indicates that RAC plays a partial mediating role in the relationship between endogenous open innovation and enterprise growth performance.

Table 19 Results of the mediating effect of realized absorptive capacity on inbound open innovation and enterprises growth performance

	Model 1	Model 2	Model 3
Constant	1.972 * * *	1.187 * * *	0.845 * * *
	(6.748)	(4.081)	(2.844)
Gender	0.042	0.038	0.043
	(0.830)	(0.798)	(0.927)
Age	0.012	0.029	0.039
	(0.198)	(0.508)	(0.695)
Company age	0.049	0.027	0.038
	(0.802)	(0.466)	(0.68)
Length of service	0.013	0.034	0.054
	(0.191)	(-0.537)	(-0.852)
Number of employees	0.033	0.046	0.055
	(0.637)	(-0.959)	(-1.179)

	Model 1	Model 2	Model 3
Annual operating income	0.30 (0.582)	0.012 (0.254)	0.009 (0.191)
Nature of company	0.017 (0.344)	0.014 (-0.299)	0.023 (-0.498)
Type of business	0.019 (0.366)	0.029 (0.618)	0.036 (0.778)
inbound open innovation		0.366 * * * (7.734)	0.325 * * * (6.848)
Mediating variable			
realized absorptive capacity (RAC)			0.193 * * * (4.059)
Sample size	400	400	400
R^2	0.007	0.132	0.164
Adjust R	0.013	0.112	0.143
F number □	F = 0.341, p = 0.950	F =6.604,p<0.001	F =7.654,p<0.001
$\triangle R^2$	0.007	0.125	0.032
△F value □	F =0.341,p=0.950	F =56.321,p<0.001	F =14.979,p<0.001
Dependent variable: Growth performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 20 presents the results of the Bootstrap analysis, indicating that the 95% confidence interval for the indirect effect is [0.0098; 0.0610], excluding 0. This demonstrates that realized absorptive capacity (RAC) plays a partial mediating role between inbound open innovation and enterprise growth performance (GP). Therefore, hypothesis H4c, which posits that realized absorptive capacity mediates the relationship between inbound open innovation and enterprise growth performance, is partially supported.

Table 20 A Bootstrap analysis of the mediating role of realized absorptive capacity (RAC)

	Effects	Effect	SE	95%CI LLCI	ULCI
The mediating role of realized Absorptive capacity (RAC)	Indirect effect(s) of X on Y:	0319.	0129.	0098.	0610.
	Direct effect of X on Y	2650.	0383.	0000.	1898.
	Total effect of X on Y	2970.	0380.	0000.	2222.

Table 21 shows the analysis of the mediating effect of realized absorptive capacity (RAC) on the relationship between outbound open innovation and enterprise growth performance. In Model 2, the standardized coefficient of outbound open innovation is 0.356 ($p < 0.001$). However, when RAC is included in Model 3, the standardized coefficient of

outbound open innovation decreases to 0.311 ($p < 0.001$). This reduction indicates that RAC plays a partial mediating role between outbound open innovation and enterprise growth performance (GP) .

Table 21 Analysis results of the mediating effect of realized absorptive capacity on outbound open innovation and enterprises growth performance

	Model 1	Model 2	Model 3
Constant	1.972 * * *	0.95 * * *	0.665
	(6.748)	(3.109)	(2.151)
Gender	0.042	0.023	0.03
	(0.830)	(0.484)	(0.643)
Age	0.012	0.004	0.017
	(0.198)	(0.074)	(0.296)
Company age	0.049	0.048	0.056
	(0.802)	(0.832)	(1.003)
Length	0.013	0.033	0.051
of service	(0.191)	(-0.509)	(0.808)
Number of employees	0.033	0.014	0.027
	(0.637)	(-0.292)	(0.57)
Annual operating	0.30	0.041	0.034
income	(0.582)	(0.854)	(0.734)
Nature of company	0.017	0.009	0.019
	(0.344)	(-0.194)	(0.398)
Type of business	0.019	0.016	0.024
	(0.366)	(0.338)	(0.518)
Outbound open innovation		0.356 * * *	0.311 * * *
		(7.505)	(6.473)
realized absorptive capacity			0.186 * * *
(RAC)			(3.87)
Sample size	400	400	400
R^2	0.007	0.132	0.164
Adjust R	0.013	0.112	0.143
F number □	F = 0.341, p = 0.950	F =6.604, p<0.001	F =7.654, p<0.001
$\triangle R^2$	0.007	0.125	0.032
△F value □	F =0.341, p=0.950	F =56.321, p<0.001	F =14.979, p<0.001
Dependent variable: Growth performance (GP)			

* p<0.05 ** p<0.01 *** p<0.001 The t value in parentheses

Table 22 shows the results of the Bootstrap analysis, indicating that the 95% confidence interval for the indirect effect is [0.0128; 0.0767], excluding 0. This demonstrates that realized absorptive capacity (RAC) partially mediates the relationship between outbound open innovation and enterprise growth performance (GP). Therefore, hypothesis H4d, which posits that realized absorptive capacity mediates the relationship between outbound open innovation and enterprise growth performance, is partially supported.

Table 22 Bootstrap analysis of the mediating role of realized absorptive capacity (RAC)

	effect	Effect	SE	95%CI	
				LLCI	ULCI
The mediating role of realized Absorptive capacity (RAC)	Indirect effect(s) of X on Y:	0412.	0165.	0128.	0767.
	Direct effect of X on Y	3106.	0466.	0000.	2189.
	Total effect of X on Y	3518.	0000.	0000.	2612.

4.4.3 Adjustment effect analysis

(1) The moderating effect of organizational forgetting on the relationship between inbound open innovation and potential absorptive capacity

Table 23 shows the analysis of the moderating effect of organizational forgetting on the relationship between inbound open innovation and potential absorptive capacity. In Model 4, the interaction term of inbound open innovation and organizational forgetting is included, resulting in a standardized coefficient of 0.388 ($p < 0.05$). This indicates that organizational forgetting moderates the relationship between inbound open innovation and potential absorptive capacity. Therefore, hypothesis H5a is supported.

Table 23 Results of the moderating effects of organizational forgetting on inbound open innovation and potential absorptive capacity

	Model 1	Model 2	Model 3	Model 4
Constant	2.53 * * *	1.806 * * *	0.916	1.616 * * *
	(7.406)	(5.166)	(2.583)	(3.290)
Gender	0.029	0.026	0.022	0.028
	(0.582)	(0.536)	(0.471)	(0.610)
Age	0.048	0.035	0.008	0.006
	(-0.789)	(0.595)	(0.148)	(0.118)
Company age	0.034	0.017	0.012	0.01
	(0.562)	(0.284)	(0.216)	(0.179)
Length of service	0.006	0.022	0.039	0.042
	(-0.081)	(0.34)	(0.632)	(0.671)
Number of employees	0.031	0.041	0.032	0.034
	(-0.607)	(0.845)	(0.695)	(0.734)
Annual operating income	0.028	0.042	0.037	0.031
	(-0.551)	(0.858)	(0.807)	(0.682)
Nature of company	0.016	0.019	0.019	0.025
	(0.322)	(0.389)	(0.409)	(0.538)
Type of business	0.038	0.047	0.06	0.06
	(0.752)	(0.957)	(1.296)	(1.317)

	Model 1	Model 2	Model 3	Model 4
Inbound open innovation		0.288 * * * (5.931)	0.288 (6.265)	0.037 (0.282)
Moderating variables				
organizational forgetting (OF)			0.318 * * * (6.924)	0.039 (0.269)
Interaction item				
inbound open innovation × Organizational forgetting				0.388 * (2.050)
Sample size	400	400	400	400
R^2	0.007	0.089	0.189	0.197
Adjust R	0.014	0.068	0.168	0.175
F number □	F = 0.321, p = 0.950	F =4.218, p<0.001	F =9.047, p<0.001	F =8.675, p<0.001
$\triangle R^2$	0.007	0.082	0.100	0.009
△F value □	F =0.321, p=0.958	F =35.171, p<0.001	F =47.943, p<0.001	F =4.204, p<0.001

Dependent variable: Potential absorptive capacity (PAC)

(2) The moderating effect of organizational forgetting on outbound open innovation and potential absorptive capacity

Table 24 presents the analysis of the moderating effect of organizational forgetting on the relationship between outbound open innovation and potential absorptive capacity (PAC). In Model 4, the interaction term of outbound open innovation and organizational forgetting (OF) is included, resulting in a standardized coefficient of 0.53 ($p < 0.05$). This indicates that organizational forgetting moderates the relationship between outbound open innovation and potential absorptive capacity. Therefore, hypothesis H5b is supported.

Table 24 Results of the moderating effects of organizational forgetting on outbound open innovation and potential absorptive capacity

	Model 1	Model 2	Model 3	Model 4
Constant	2.530 * * * (7.406)	1.369 * * * (3.818)	0.709 * (1.968)	1.683 * * (3.046)
Gender	0.029 (0.582)	0.011 (0.23)	0.009 (0.197)	0.017 (0.384)
Age	0.048 (-0.789)	0.055 (-0.972)	0.031 (-0.574)	0.033 (-0.597)

	Model 1	Model 2	Model 3	Model 4
Company age	0.034 (0.562)	0.033 (0.573)	0.029 (0.526)	0.030 (0.543)
Length of service	0.006 (-0.081)	0.025 (-0.382)	0.038 (-0.608)	0.034 (-0.556)
Number of employees	0.031 (-0.607)	0.013 (-0.27)	0.007 (-0.148)	0.012 (-0.262)
Annual operating income	0.028 (-0.551)	0.017 (-0.361)	0.014 (-0.313)	0.006 (-0.123)
Nature of company	0.016 (0.322)	0.024 (0.51)	0.023 (0.512)	0.025 (0.549)
Type of business	0.038 (0.752)	0.036 (0.749)	0.047 (1.038)	0.046 (1.006)
Outbound open innovation		0.346 * * * (7.262)	0.31 * * * (6.742)	0.015 (0.113)
Regulating variables				
organizational forgetting (OF)			0.278 * * * (6.057)	0.114 (0.648)
Outbound open innovation × Organizational forgetting (OF)				0.53 * (2.315)
Sample size	400	400	400	400
R2	0.007	0.125	0.200	0.211
Adjust R2	0.014	0.105	0.180	0.189
F number □	F = 0.321, p = 0.950	F =6.182, p<0.001	F =9,741, p<0.001	F =9.442, p<0.001
△R2	0.007	0.118	0.075	0.011
△F value □	F =0.321, p=0.950	F =52.743, p<0.001	F =36.685, p<0.001	F =5.361, p<0.001

Dependent variable: Potential absorptive capacity (PAC)

(3) The moderating effect of organizational forgetting between inbound open innovation and realized absorptive capacity

Table 25 presents the analysis of the moderating effect of organizational forgetting on the relationship between inbound open innovation and realized absorptive capacity (RAC). In Model 4, the interaction term of inbound open innovation and organizational forgetting (OF) is included, resulting in a standardized coefficient of 0.426 ($p < 0.05$). This indicates that organizational forgetting moderates the relationship between inbound open innovation and realized absorptive capacity. Therefore, hypothesis H5c is supported.

Table 25 Results analysis of the moderating effect of organizational forgetting between inbound open innovation and realized absorptive capacity

	Model 1	Model 2	Model 3	Model 4
Constant	2.395 * * * (7.641)	1.906 * * * (5.822)	1.314 * * * (3.844)	2.023 * * * (4.273)
Gender	0.025 (-0.494)	0.027 (-0.556)	0.031 (-0.638)	0.024 (-0.494)
Age	0.061 (-1.005)	0.051 (-0.863)	0.032 (-0.554)	0.03 (-0.524)
Company age	0.047 (-0.765)	0.06 (-0.998)	0.063 (-1.084)	0.065 (-1.128)
Length of service	0.112 (1.642)	0.10 (1.492)	0.087 (1.344)	0.085 (1.312)
Number of employees	0.057 (1.113)	0.049 (00.983)	0.056 (1.147)	0.053 (1.105)
Annual operating income	0.026 (0.522)	0.016 (0.328)	0.02 (0.406)	0.026 (0.541)
Nature of company	0.045 (0.884)	0.047 (0.942)	0.047 (0.966)	0.053 (1.104)
Type of business	0.042 (-0.83)	0.036 (-0.723)	0.026 (-0.547)	0.025 (-0.533)
inbound open innovation		0.211 * * * (4.279)	0.211 * * * (4.388)	0.065 (-0.475)
Moderating variables				
organizational forgetting (OF)			0.229 * * * (4.770)	0.078 (0.517)
inbound open innovation × Organizational forgetting (OF)				0.426 * (2.154)
Sample size	400	400	400	400
R^2	0.016	0.060	0.112	0.122
Adjust R	0.004	0.038	0.089	0.097
F number □	F = 0.785, p = 0.616	F =2.763, p<0.001	F =4.900, p<0.001	F =4.919, p<0.001
$\triangle R^2$	0.016	0.044	0.052	0.010
△F value □	F =0.785, p=0.616	F =18.310, p<0.001	F =22.752, p<0.001	F =4.641, p=0.032

Dependent variable:realized absorptive capacity (RAC)

(4) The moderating effect of organizational forgetting on outbound open innovation and real absorptive capacity

Table 26 shows the analysis of the moderating effect of organizational forgetting on the relationship between outbound open innovation and realized absorptive capacity (RAC). In Model 4, the interaction term of outbound open innovation and organizational forgetting (OF) is included, resulting in a standardized coefficient of 0.604 ($p < 0.001$). This indicates that organizational forgetting moderates the relationship between outbound open innovation and realized absorptive capacity. Therefore, hypothesis H5d is supported.

Table 26 Results analysis of the moderating effects of organizational forgetting on outbound open innovation and realized absorptive capacity

	Model 1	Model 2	Model 3	Model 4
Constant	2.395 * * * (7.641)	1.647 * * * (4.837)	1.206 * * * (3.450)	2.231 * * * (4.162)
Gender	0.025 (-0.494)	0.038 (-0.772)	0.039 (-0.817)	0.030 (-0.618)
Age	0.061 (-1.005)	0.066 (-1.125)	0.049 (-0.843)	0.050 (-0.871)
Company age	0.047 (-0.765)	0.048 (-0.804)	0.050 (-0.870)	0.050 (-0.861)
Length of service	0.112 (1.642)	0.099 (1.488)	0.089 (1.374)	0.093 (1.443)
Number of employees	0.057 (1.113)	0.069 (1.398)	0.074 (1.520)	0.068 (1.405)
Annual operating income	0.026 (0.522)	0.034 (0.690)	0.036 (0.748)	0.046 (0.958)
Nature of company	0.045 (0.884)	0.050 (1.024)	0.050 (1.031)	0.051 (1.075)
Type of business	0.042 (-0.830)	0.044 (-0.889)	0.035 (-0731)	0.037 (-0.777)
Outbound open innovation		0.242 * * * (4.929)	0.216 * * * (4.452)	0.120 (-0.846)
Regulating variables				
organizational forgetting (OF)			0.201 * * * (4.167)	0.245 (-1.329)
Outbound open innovation × Organizational forgetting (OF)				0.604 * * * (2.509)
Sample size	400	400	400	400
R^2	0.016	0.074	0.113	0.127
Adjust R	0.004	0.052	0.090	0.103
F number □	F = 0.785, p =	F =3.439,	F =4.961,	F =5.143,

	Model 1	Model 2	Model 3	Model 4
	0.616	p<0.001	p<0.001	p<0.001
$\triangle R^2$	0.016	0.058	0.040	0.014
△F value □	F =0.785,F =24.297,F =17.360,F =6.296, p=0.616	p<0.001	p<0.001	p<0.001

Dependent variable: realized absorptive capacity (RAC)

Hypothetical content	Verification case
H1a: Inbound open innovation has a significant positive impact on enterprise growth performance;	Accepted
H1b: Outbound open innovation has a significant positive impact on enterprise growth performance;	Accepted
H2a: Inbound open innovation has a positive effect on potential absorptive capacity;	Accepted
H2b: Outbound open innovation has a positive effect on potential absorptive capacity;	Accepted
H2d: Inbound open innovation has a positive effect on realized absorptive capacity;	Accepted
H2e: Outbound open innovation has a positive effect on realized absorptive capacity;	Accepted
H3a: Potential absorptive capacity has a positive impact on enterprise growth performance;	Accepted
H3b:Realized absorptive capacity has a positive impact on enterprise growth performance;	Accepted
H4a: Potential absorptive capacity plays a mediating role in inbound open innovation and enterprises growth performance	Accepted
H4b: Potential absorptive capacity plays a mediating role in outbound open innovation and enterprises growth performance	Accepted
H4d Realized absorptive capacity plays a mediating role in inbound open innovation and enterprises growth performance	Accepted
H4e:Realized absorptive capacity plays an intermediary role in outbound open innovation and enterprises growth performance	Accepted
H5a: Organizational forgetting positively modulates the effect of inbound open innovation on potential absorptive capacity	Accepted
H5b: Organizational forgetting positively modulates the effect of outbound open innovation on potential absorptive capacity	Accepted
H5d: Organizational forgetting positively modulates the effect of inbound open innovation on real-world absorptive capacity	Accepted
H5e: Organizational forgetting positively modulates the effect of outbound open innovation on real-world absorptive capacity	Accepted

In summary, this study tested five hypotheses related to the impact of open innovation on enterprise growth performance, the moderating effect of organizational forgetting, and the mediating role of technology absorptive capacity. The results verified most of the proposed hypotheses, effectively addressing the research questions and achieving the initial objectives. The main research content has been completed. Table 27 summarizes the verification of the 16 hypotheses presented in this study.

Table 27 Summary table of hypothesis testing in this study

5. Discussion and conclusion

The path analysis conducted in this study provides a comprehensive understanding of the dynamics between open innovation, technology absorptive capacity, organizational forgetting, and enterprise growth performance. The results demonstrate that inbound open innovation significantly enhances growth performance both directly and through the mediation of potential and realized absorptive capacity. Notably, the positive direct effects of inbound open innovation on growth performance (H1) and the significant mediation roles of potential and realized absorptive capacity (H4a, H4b) underscore how effective resource acquisition and integration foster competitive advantage. Furthermore, the mediation effect of organizational forgetting (H5) suggests that eliminating obsolete knowledge facilitates the absorption and application of new technologies, enhancing innovation and growth. These findings indicate that by strategically implementing open innovation and managing organizational forgetting, enterprises can significantly improve their growth performance. This approach not only bolsters innovation capacity but also ensures sustained competitive advantage in a dynamic market environment.

5.1 Theoretical implication

Enterprise growth theory posits that a firm's expansion is driven by its ability to optimize resource utilization and innovate continuously. Freixanet and Renart (2020) introduced the concept of internal growth, emphasizing resource and capability management as essential for expansion. Our study supports this theory by demonstrating that technology absorptive capacity, a crucial resource management capability, significantly mediates the relationship between open innovation and enterprise growth performance. This aligns with Hafiz et al. (2022) that managing resources and capabilities is vital for growth. However, our findings extend this by highlighting the role of organizational forgetting in facilitating this process, an aspect less emphasized in traditional growth theory.

Innovation theory suggests that continuous innovation is critical for sustaining competitive advantage (Tu & Wu, 2021). Our study corroborates this by showing that both inbound and outbound open innovation positively impact enterprise growth performance. This is consistent with findings by Moradi et al. (2021), who noted the positive effects of open innovation on firm performance. However, our research also reveals the nuanced role of absorptive capacity in this dynamic. Specifically, realized absorptive capacity significantly enhances the impact of open innovation on growth, supporting Aliasghar et al. (2023) assertion that absorptive capacity is crucial for leveraging external knowledge for innovation. This dual focus on potential and realized absorptive capacity provides a more comprehensive understanding of how firms can sustain innovation-driven growth.

Resource dependence theory posits that organizations must engage in strategic resource exchanges to manage dependencies and uncertainties (S. T. Kim et al., 2020). Our findings support this theory by demonstrating that open innovation, which involves extensive external collaborations, enhances firms' technological capabilities and growth performance. This is in line with studies by Zahra et al. (2020), who highlighted the benefits of external knowledge integration. However, our research adds to this by showing that the process of organizational forgetting is critical in effectively managing these external resources. By discarding obsolete knowledge, firms can better absorb and apply new technologies, thus optimizing their

resource dependence strategy.

While previous studies have extensively documented the positive effects of open innovation on firm performance (Hameed et al., 2021), our research provides deeper insights into the mechanisms underlying this relationship. Specifically, we identify technology absorptive capacity as a vital mediator, a factor less prominently featured in earlier studies. Furthermore, the role of organizational forgetting in enhancing absorptive capacity and innovation performance is a novel contribution, providing a fresh perspective on how firms can maintain competitive advantage in rapidly changing markets.

5.2 Practical implication

The results of this study have significant managerial implications for stakeholders across various sectors, particularly in how open innovation and technology absorptive capacity are managed to enhance enterprise growth performance. These insights are vital for managers, policymakers, investors, and employees committed to fostering innovation and sustainable growth.

Managers should leverage the study's findings on the positive impacts of inbound and outbound open innovation on growth performance. This suggests that fostering a culture of innovation and collaboration through strategic partnerships and external knowledge acquisition can significantly enhance a company's competitive advantage. Managers should invest in training programs to build employees' absorptive capacities, ensuring that the organization can effectively assimilate and utilize new knowledge. Implementing knowledge management systems that facilitate organizational forgetting will also help maintain agility and innovation.

Policymakers should develop supportive frameworks that encourage open innovation and the integration of external knowledge. This includes creating incentives for collaborative R&D projects and establishing regulations that promote knowledge sharing while protecting intellectual property. By fostering an environment conducive to innovation, policymakers can enhance the overall competitiveness of the industry.

Investors can use the study's insights to assess a firm's potential for sustainable growth. Firms with strong absorptive capacities and active open innovation practices are likely to have a competitive edge and greater long-term growth potential. Investors should consider these factors when making investment decisions.

Employees play a crucial role in the success of open innovation initiatives. Understanding that effective participation in external collaborations and continuous learning are linked to improved performance can motivate employees to engage more proactively with innovation activities. Companies should encourage employees to attend workshops and training sessions that enhance their ability to acquire, integrate, and apply new knowledge.

IT Departments should focus on providing robust, user-friendly digital tools that support the efficient exchange of information and resources, facilitating both synchronous and asynchronous interactions. Considering that technology stress can impact performance, IT support should include comprehensive technical assistance and training programs to minimize stress associated with adopting new technologies.

In conclusion, the insights from this study should guide the strategic development and implementation of open innovation and absorptive capacity initiatives. Emphasizing effective communication, collaboration, and the systematic management of organizational knowledge

can significantly enhance enterprise growth performance. These strategies not only aim to improve individual and organizational performance but also elevate overall industry standards and outcomes.

5.3 Conclusion

This study provides a comprehensive analysis of the interplay among open innovation, technology absorptive capacity, organizational forgetting, and enterprise growth performance. The findings indicate that both inbound and outbound open innovation significantly enhance enterprise growth performance. This relationship is mediated by technology absorptive capacity, which includes both potential and realized absorptive capacities. Our results underscore the importance of organizational forgetting as a mechanism that facilitates the absorption and application of new knowledge, thereby enhancing the effectiveness of open innovation strategies. Specifically, the study shows that effective management of inbound and outbound innovation, combined with a robust absorptive capacity and a deliberate practice of organizational forgetting, leads to significant improvements in enterprise growth performance.

This study makes several key contributions to the existing body of knowledge on open innovation and enterprise growth. First, it integrates enterprise growth theory, innovation theory, and resource dependence theory, providing a holistic understanding of how open innovation practices can drive growth. Second, the study highlights the critical role of technology absorptive capacity as a mediator in the relationship between open innovation and growth performance. This dual focus on potential and realized absorptive capacity offers a nuanced understanding of how firms can effectively leverage external knowledge. Third, the introduction of organizational forgetting as a facilitator of absorptive capacity provides new insights into how firms can manage and optimize their knowledge bases to support continuous innovation and growth. These contributions extend the theoretical frameworks and offer practical implications for managers, policymakers, and other stakeholders.

Despite its contributions, this study has several limitations. First, the research is based on survey data from 'Little Giant' enterprises in China, which may limit the generalizability of the findings to other contexts or industries. Second, the study relies on self-reported data, which could introduce biases related to social desirability or respondent subjectivity. Third, while the study provides a comprehensive analysis of the relationships between open innovation, absorptive capacity, and growth performance, it does not account for other potential mediators or moderators, such as organizational culture or external market conditions, that could also influence these relationships.

Building on the limitations identified, future research should aim to extend the generalizability of these findings by conducting similar studies in different industries and geographic contexts. Comparative studies across different cultural and economic environments could provide deeper insights into how open innovation practices are adopted and their effects on growth performance. Additionally, future research could incorporate longitudinal data to examine how the relationships between open innovation, absorptive capacity, and growth performance evolve over time. This approach would help to capture the dynamic nature of these constructs and provide more robust evidence of causality. Furthermore, investigating other potential mediators and moderators, such as organizational culture, leadership styles, and market dynamics, could enrich the understanding of the

conditions under which open innovation and absorptive capacity most effectively drive enterprise growth. Finally, qualitative studies could complement the quantitative findings by exploring the lived experiences of managers and employees engaged in open innovation practices, offering a more detailed understanding of the challenges and best practices in managing innovation and growth.

In conclusion, this study underscores the vital role of open innovation and technology absorptive capacity in driving enterprise growth performance. By integrating key theoretical perspectives and providing empirical evidence, it offers valuable insights for both academia and practice. Future research should continue to explore these relationships, addressing the limitations and extending the findings to broader contexts, to further enhance our understanding of how firms can strategically manage innovation and growth in an increasingly complex and dynamic environment.

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