“The effects of search breadth and search depth on the product innovation of young firms: Evidence from Thai manufacturing industry”

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THE EFFECTS OF SEARCH BREADTH AND SEARCH DEPTH ON THE PRODUCT INNOVATION OF YOUNG FIRMS: EVIDENCE FROM THAI MANUFACTURING INDUSTRY

Abstract

While the majority of open innovation literature focuses on established firms, this study extends the existing literature by examining young and newly market-entrant firms. The purpose of this study is to investigate the impact of two open search strategies – search breadth and search depth – on the product innovation of young firms. The study focuses on the manufacturing industry due to its higher propensity for product innovation compared to the service sector. The data were collected via a postal survey of manufacturing firms in Thailand, conducted between March and August 2021. Respondents consisted exclusively of CEOs or senior managers, yielding a final sample of 423 firms for analysis. The analysis employed Negative Binomial Regression (NBR), a statistical method suitable for data violating the mean-variance equality assumption inherent in this dataset. The results reveal that search breadth exerts a statistically significant positive influence on product innovation. An inverted U-shaped relationship between search breadth and product innovation is not statistically significant. Search depth has a statistically significant negative effect on product innovation. Finally, an inverted U-shaped relationship between search depth and product innovation is statistically significant, indicating that greater search depth corresponds to diminished innovation. In summary, the findings suggest that search breadth benefits product innovation in young firms, whereas search depth hurts their product innovation.

Keywords search breadth, search depth, product innovation, young firms, Thailand

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INTRODUCTION

Open innovation and external knowledge sourcing are widely recognized as critical factors in enhancing a firm's innovative capabilities (Caloghirou et al., 2004; Cassiman & Veugelers, 2006; Doloreux et al., 2019; Rodriguez et al., 2017). Firms can acquire external knowledge through two primary search strategies: search breadth and search depth (Ferreras-Méndez et al., 2015; Greco et al., 2016; Laursen & Salter, 2006; Zang et al., 2014). While search breadth emphasizes interactive learning with diverse partners to acquire novel knowledge distinct from the firm's existing knowledge base, search depth focuses on intensive engagements with a selected few organizations to deepen and specialize the firm's current knowledge base (Laursen & Salter, 2006).

While the effects of these two knowledge search strategies on innovation in established firms are well-documented, research on their impact on the innovative capabilities of young firms remains limited. As late entrants, young firms must actively develop innovations to com-

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pete with incumbent competitors, making external knowledge sourcing essential for their innovation efforts. A critical question arises: Which strategy – breadth or depth – has a greater impact on the innovation performance of young firms? This question is particularly significant for young firms because they are often resource-constrained and must allocate their limited resources as efficiently as possible to maximize innovation outcomes (Kraus et al., 2020; Protogerou et al., 2017).

Since each knowledge search strategy entails distinct costs, risks, and considerable resources, firms must adopt these strategies at the optimal level. Breadth and depth strategies both may promote innovations, but excessive reliance on either approach may adversely affect innovative performance (Ferreras-Méndez et al., 2015; Laursen & Salter, 2006). Thus, young firms should prioritize the strategy that maximizes their innovation outcomes while maintaining an efficient balance in resource allocation (Bruneel et al., 2010; Yli-Renko et al., 2001). However, empirical evidence on the optimal configuration of search breadth and depth for young firms remains scarce in the existing literature.

1. LITERATURE REVIEW AND HYPOTHESES

1.1. Open search strategies

Open search is a firm's strategy of using external knowledge for innovative activities. Firms undertake an open search strategy to complement their internal knowledge resources to enhance their innovative capabilities (Laursen & Salter, 2006). Due to rapid technological change, shortened product life cycles, and the widespread distribution of specialized knowledge, firms can no longer pursue their innovative activities alone (Chesbrough et al., 2006; Chesbrough, 2017). Even large firms with considerable R&D capacity acquire knowledge from outside to complement their internal knowledge-generation activities (Chesbrough, 2003). Open search is necessary for young and small firms as they need external knowledge to compensate for their limited internal knowledge-generation capabilities (Gimenez-Fernandez et al., 2019).

The external knowledge-sourcing literature suggests external knowledge sources from which firms can obtain insights to enhance their innovative capability, including customers, suppliers, competitors, knowledge-intensive business services (KIBSs), industrial and trade associations, universities, public research organizations (PROs), and government agencies. Each of these sources possesses different types of knowledge and expertise. Consequently, they can be regarded as separate search spaces, often requiring different organizational practices for effective knowledge acquisition (Laursen & Salter, 2006).

The open search literature proposes that firms could benefit from two different strategies of external knowledge sourcing – search breadth and search depth (Laursen & Salter, 2006). On the one hand, firms that source knowledge from a wide range of sources (i.e., search breadth) can obtain diverse information, which increases the possibility of recombining various pieces of information to produce novel insights (Kobarg et al., 2019; Zang et al., 2014; Zhou & Li, 2012). On the other hand, firms can also benefit from sourcing knowledge intensively from particular knowledge actors (i.e., search depth). Through intensive knowledge interaction with some actors, firms can gain a deep understanding of specialized technological fields, enabling them to develop the capacity to refine their existing knowledge and exploit its value. Additionally, intensive interaction reduces misunderstandings, mistrust, and information leaks in knowledge transfer, thereby reducing transaction costs and enhancing the effectiveness of knowledge transmission (Flor et al., 2018; Martini et al., 2012; Xu, 2015).

A study on young firms' external knowledge acquisition for innovative activities is scarce (Friesl, 2012; Kraus et al., 2020). This is surprising given that these firms are likely to seek external knowledge as their internal knowledge generation capabilities are limited (Hughes et al., 2007; Protogerou et al., 2017). Some scholars argue that external knowledge sourcing is crucial for the survival of young firms (Chandler & Lyon, 2009) and their innovation performance (Li, 2022). Thus, if external knowledge is so necessary, it is relevant to examine the external knowledge acquisition strategy that is most effective for the innovation performance of young firms.

1.2. Search breadth and innovation

Search breadth is defined as a firm's strategy to acquire knowledge from a wide range of sources (Laursen & Salter, 2006). In empirical works, breadth is generally measured as the number of different sources from which firms acquire knowledge, regardless of how intensively knowledge is acquired from each source (Ferreras-Méndez et al., 2015; Radicic, 2021; Ye et al., 2023). There are some ways in which search breadth can enhance firms' innovativeness. First, from the resource-based view (Mowery et al., 1998), interacting with various knowledge actors can also mean access to a great diversity of resources and assets. When firms are connected to a diverse knowledge network, they can benefit from resources and assets that are pooled and shared, thereby increasing resource complementarity and leading to improved innovation performance (Kobarg et al., 2019; Nieto & Santamaria, 2007).

Second, based on the knowledge recombination perspective (Savino et al., 2017; Xiao et al., 2022), innovations tend to build on new knowledge components and are the result of the recombination of those components. Acquiring new knowledge components that differ from a firm's existing knowledge can increase the possibilities of knowledge recombination to generate novel innovations (Xiao et al., 2022). New knowledge components can alter firms' perceptions, provide firms with alternatives to solving technical problems, and help them avoid the risk of cognitive lock-in (Barbieri et al., 2020; Visser & Boschma, 2004). In this case, obtaining knowledge from various sources enlarges the set of new knowledge components from which firms can recombine to generate novel insights (Leiponen & Helfat, 2010). Firms taking a search breadth strategy and seeking knowledge widely across multiple knowledge domains will have more choices for knowledge recombination and are likely to have better innovative performance than firms that search narrowly (Savino et al., 2017; Xiao et al., 2022).

Third, searching for knowledge from multiple sources can augment a firm's absorptive capacity, which is essential for its innovative capability (Ferreras-Méndez et al., 2015). As firms source knowledge from various actors, they learn to explore and evaluate relevant information, acquire and transform it into new organizational knowledge, and exploit new knowledge for a commercial end (Ferreras-Méndez et al., 2016).

Finally, as the outcomes of external knowledge search activities are generally uncertain and the payoff cannot be fully realized beforehand (Nelson & Winter, 1982), diversifying the knowledge sources in the search process can help firms mitigate the risks and uncertainty associated with their search activities (Gimenez-Fernandez et al., 2020).

Though the number of studies examining the relationship between search breadth and young firms' innovations is limited, a few notable studies suggest a positive and significant relationship. Gimenez-Fernandez et al. (2020) examine the impacts of the knowledge-sourcing breadth and R&D investment on the innovation performance of young and old SMEs in Spain. The results show that breadth exerts a more substantial positive effect on the innovation performance of young SMEs than older SMEs, who benefit more from in-house R&D investment. Similarly, Gimenez-Fernandez et al. (2019) find that cooperation breadth, measured as the number of cooperation partners, is positive and significant on young firms' product innovation performance. This effect is particularly pronounced for young firms in the high-tech industry, where products are more complex and knowledge is more distributed, necessitating that small, young firms with limited knowledge-generation capabilities source knowledge externally. Additionally, Pangarkar and Wu (2013) demonstrate that a large number of alliances and alliance partner diversity have a positive and significant impact on the innovation performance of startup firms. These scholars suggest that young firms can access a wide range of complementary resources by establishing alliances with diverse partners, resulting in superior innovation performance. All these findings align with the search breadth thesis.

Therefore, drawing on the extant literature, it can be argued that young firms adopting a search breadth strategy enhance their innovative capabilities. This approach facilitates access to novel and complementary knowledge resources, increases the potential for knowledge recombina-

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tion, strengthens absorptive capacity, and mitigates risks and uncertainties inherent in innovation processes.

1.3. Search depth and innovation

Search depth refers to a firm's strategy to acquire knowledge intensively from specific knowledge sources (Chiang & Hung, 2010; Laursen & Salter, 2006). The argument for the influence of search depth on superior innovation performance can be found in the relational view (Borgatti & Cross, 2003; Dyer & Singh, 1998). According to this perspective, firms can achieve superior innovation performance by tapping into long-term inter-organizational networks and establishing close ties with other organizations in the network (Zheng et al., 2013). As external knowledge acquisition often involves transferring complex technological knowledge, effectively transmitting it requires intensive interactions between firms and their partners (Ferreras-Méndez et al., 2016). Also, the tacit knowledge component tends to be effectively transferred through strong inter-organizational ties (Tamer Cavusgil et al., 2003). Thus, search depth can be an effective mechanism for transferring tacit knowledge. Moreover, based on intensive and long-term interactions between firms and their knowledge partners, search depth will strengthen trust and social capital, thereby reducing opportunistic behavior and transaction costs in knowledge exchange and making knowledge transfer more stable and effective (Terjesen & Patel, 2017).

The positive and significant effect of search depth on firms' innovativeness is highlighted by many studies (e.g., Chiang & Hung, 2010; Flor et al., 2018; Martini et al., 2012). However, there has been limited research on the relationship between search depth and the innovation performance of young firms. According to Friesl (2012), young firms tend to be specialized in a particular field of technology or a specific product segment. Their knowledge base tends to be narrower and less diversified than that of older companies. Consequently, they will likely adopt an exploitative learning strategy and source knowledge from familiar technological fields to optimize their specialized and narrow knowledge base. Additionally, Yli-Renko et al. (2001) find that social capital, conceptualized as social interaction, quality of relationships, and strong network ties with key customers, facilitates knowledge acquisition in young high-tech firms and results in superior product innovation performance.

Building on the existing literature, it can be argued that young firms pursuing a search depth strategy improve their innovative performance by gaining access to complex technological knowledge. Such knowledge often necessitates intensive interactions to facilitate efficient transfer. Furthermore, since the search depth approach relies on trust-based relationships, it lowers transaction costs in knowledge exchange, thereby enhancing the effectiveness of assimilating sophisticated technological expertise.

1.4. Over-search effects

The impact of search breadth and depth on innovation performance is not always positive. At some point, continuous increases in the breadth and depth of knowledge search may result in diminishing returns – the point at which the over-search effect becomes predominant (Laursen & Salter, 2006). Over-search effects may occur in many ways. First, according to the transaction cost perspective, when firms source knowledge broadly or intensively from many external knowledge partners, the coordination and monitoring costs increase (Guo & Wang, 2014). With a large number of knowledge partners, it would be costly for firms to monitor all partners' behaviors, allowing opportunistic behaviors to occur and making some knowledge-sourcing activities inefficient (Sampson, 2004; Wang et al., 2021).

Second, based on the attention-based view (Ocasio, 1997), when firms source knowledge widely or intensively, managers with limited time and cognitive capacity may struggle to allocate their attention to all the information obtained from those sources (Laursen & Salter, 2006; Radicic, 2021). Managers' attention is regarded as a critical resource of the firm, which will be fully leveraged when managers focus on particular issues (Ocasio, 1997). However, when there are too many ideas sourced from outside, managers may not be able to devote their attention to all those ideas. Consequently, some incoming information will be unutilized and become redundant (Radicic, 2021; Terjesen & Patel, 2017).

Third, each knowledge source is a separate entity with specific norms and organizational settings, requiring the knowledge-acquiring firms to develop different practices and routines for obtaining knowledge from each source (Laursen & Salter, 2006). Thus, when the number of sources for knowledge acquisition increases, firms bear higher managerial costs of knowledge acquisition. Sourcing external knowledge in this way requires young firms to allocate their limited managerial resources to acquire knowledge from multiple sources (Greco et al., 2016; Xu, 2015), making their knowledge-sourcing activities less optimal.

Ultimately, successful knowledge sourcing requires a certain level of absorptive capacity to identify relevant knowledge and leverage it for commercial benefits (Cohen & Levinthal, 1990; Zahra & George, 2002). However, as young firms have limited absorptive capacity (Gray, 2006), acquiring knowledge from multiple sources would exhaust their absorptive capacity (Radicic, 2021; Xu, 2015), thereby deteriorating their innovation performance.

Many empirical studies demonstrate that the breadth and depth of knowledge search have a curvilinear effect on firms' innovation performance, exhibiting an inverted U-curve relationship (e.g., Chen et al., 2011; Greco et al., 2016; Kobarg et al., 2019; Laursen & Salter, 2006; Xu, 2015). In the case of young firms, Gimenez-Fernandez et al. (2019) and Gimenez-Fernandez et al. (2020) find that search breadth has an inverted U-curve relationship with firms' innovation performance, while Pangarkar and Wu (2013) also report a similar finding. However, existing studies have not examined the curvilinear relationship between search depth and innovation in young firms.

Given the costs associated with external knowledge search strategies and the substantial resources required for such activities, both breadth and depth approaches can positively influence young firms' innovation performance – but only up to an optimal level of search intensity. Beyond this threshold, excessive search breadth or depth may diminish innovative outcomes. In other words, the relationship between these search strategies and innovation follows an inverted U-shaped curve, where moderate levels of search yield the greatest benefits, while overextension proves detrimental.

In summary, the objective of this study is to investigate the impact of search breadth and search depth (two open search strategies) on the innovation performance of young firms. The following four hypotheses are formulated based on the above literature review. The first two hypotheses (hypothesis 1 and hypothesis 2) test the linear effects of search breadth and search depth on young firms' innovation, while the last two hypotheses (hypothesis 3a and hypothesis 3b) examine the curvilinear effects of breadth and depth on innovation.

H1: Search breadth is essential for young firms' innovation performance.

H2: Search depth is significant for young firms' innovation performance.

H3a: The effect of search breadth on young firms' innovation performance is curvilinear, exhibiting an inverted U-curve relationship.

H3b: The effect of search depth on young firms' innovation performance is curvilinear, exhibiting an inverted U-curve relationship.

2. METHODS

2.1. Data

The sampling frame for this study consists of manufacturing firms operating in Thailand. The manufacturing sector was selected as the focus of this research due to its empirically demonstrated greater propensity for generating technological innovations compared to the service sector (Arundel & Kabla, 1998; Pavitt, 1984; Tether, 2005). Firm-level data were obtained from the Department of Industrial Work's (DIW) Manufacturing Industry Database, the most comprehensive and authoritative registry of manufacturing enterprises in Thailand. As of January 2021, the database contained records for 73,000 registered manufacturing firms. This publicly accessible repository provides essential information, including firm names, postal and email addresses, and telephone numbers.

The data collection was done primarily by postal survey, which was carried out in two rounds: March–May and June–August 2021. The question-

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naire was developed based on relevant literature. It was revised several times based on comments and suggestions from six innovation management experts to ensure its content validity. Questionnaires were sent out in March 2021 to 5,000 randomly selected firms. The official cover letter was sent along with the questionnaire, with the following key details. First, it requested that owners or top-level executives complete the questionnaire in order to obtain the most reliable information. Second, it certified the confidentiality and anonymity of the firm-related information, which would be used solely for research purposes and would not be disclosed under any circumstances without explicit consent.

By the end of May, only 193 questionnaires were returned with complete information (3.86% response rate).[1] Due to a low response rate, a second-round survey was conducted by resending questionnaires to 2,000 firms that did not respond in the first round, along with follow-up emails and telephone calls. By the end of August, 230 complete questionnaires were returned. Therefore, there are 423 respondent firms from the two rounds of survey, of which 60 (14.2%) are young firms (1–5 years old) and 363 (85.8%) are older firms.

The non-response bias in the dataset was examined by comparing the age, employee count, export share, and foreign investment share of first-round and second-round respondent firms. The results from the independent *t*-test show no statistically significant difference in means between the two samples, indicating that non-response bias is not a severe issue. The common method bias was also checked using Harman's one-factor test (Podsakoff & Organ, 1986). The result of the exploratory factor analysis showed that no single factor dominated the majority of variance, suggesting that the common method bias issue is negligible.

2.2. Variables

2.2.1. *Dependent variable – Product innovation*

The dependent variable in this study is the firms' product innovation. This study focuses on product innovation because it is vital for the survival and competitiveness of young firms (Marion et al., 2012). Specifically, when competing with incumbent firms for market share, young firms must introduce new products or products that differ from those of incumbent firms (Antolín-López et al., 2015). Product innovation is measured by the number of new products that firms have introduced into markets over the past three years, regardless of whether the products are new to firms or new to markets.

2.2.2. *Independent variables*

Key independent variables in this study are open search breadth (BREADTH) and open search depth (DEPTH). The sample firms were asked to indicate the degree to which each of the eight external knowledge sources is important for firms' technology development and innovation, including competitors, suppliers, clients, KIBSs, industry associations, universities, PROs, and government agencies. The degree of importance is measured on a six-point Likert scale (0 = not important at all / 5 = most important).

Open search variables "BREADTH" and "DEPTH" are constructed following the conventional method used by previous studies (e.g., Chiang & Hung, 2010; Chen et al., 2011; Kobarg et al., 2019; Laursen & Salter, 2006). BREADTH is constructed by transforming the degree of importance of each knowledge source (0–5) into a binary variable, coding 1 if the degree of importance is originally 1–5 and 0 otherwise. Then, a variable BREADTH is derived by summing across eight sources, and it is represented as the whole number between 0 (when a firm did not acquire knowledge from any source) and 8 (when a firm acquired knowledge from all eight sources) (Cronbach's alpha = 0.935). Similarly, DEPTH is constructed by recoding the degree of importance of each knowledge source into a binary variable, assigning 1 if the degree of importance is originally 4 or 5, and 0 otherwise, then summing across all knowledge sources to give the whole number between 0 and 8 (Cronbach's alpha = 0.857). Conceptually, BREADTH captures the variety of sources from which firms acquire knowledge, while DEPTH denotes the intensity of knowledge acquisition (Laursen & Salter, 2006). To test

1 The low response rate is attributable to the country-wide COVID-19 lockdown during the survey period.

for curvilinear effects of BREADTH and DEPTH, the square terms of these variables (BREADTH2 and DEPTH2) were used. Variables BREADTH, DEPTH, and their square terms are mean-centered to mitigate the structural multicollinearity problem.

A binary dummy variable, YOUNG, is produced to capture the group of young enterprises. In this study, the age range of 1–5 years is used to identify young firms, consistent with Li (2022), because this age range can capture the group of startup firms, which are regarded as an important engine of an innovative economy (Choi et al., 2020). The variable YOUNG is coded as one if the firm's age is five or less, and zero otherwise. To analyze the effect of open search strategies (BREADTH, BREADTH2, DEPTH, and DEPTH2) on young firms' product innovation, this study follows the approach used by Gimenez-Fernandez et al. (2019) and Gimenez-Fernandez et al. (2020) by interacting each open search variable with the young-firm dummy variable (i.e., BREADTH*YOUNG and DEPTH*YOUNG).

Some variables are included to control for their potential impacts on firms' product innovation, including SIZE, SKILL, EXPORT, R&D, and industrial sector dummies. SIZE is measured as the number of full-time employees (log). SKILL is the share of employees with higher education. EXPORT is the share of the revenue received from exports. R&D is the average annual R&D expenditure in the past three years (log). Industry dummies are also added to control for specific sectoral effects on firms' product innovation. The dummy variables – SECTOR1, SECTOR2, SECTOR3, and SECTOR4 – are created according to Pavitt's taxonomy (Pavitt, 1984). SECTOR1 represents supplier-dominated industries (textile, clothes, leather, wood products, paper, printing, furniture, repair, and others). SECTOR2 denotes scale-intensive industries (foods, beverages, tobacco, non-metallic, metal, and fabricated metals). SECTOR3 refers to specialist supplier industries (machinery, motor vehicles, and auto parts). Finally, SECTOR4 represents science-based industries (petrochemicals, pharmaceuticals, computers and electronics, and electrical devices). SECTOR4 is a baseline sector.

SIZE is expected to be positively associated with firms' innovation performance, as large firms possess more resources to invest in innovation-related activities (Noori et al., 2017). SKILL is also expected to positively affect innovation, as firms with a greater share of knowledgeable workers tend to have a larger knowledge stock and to acquire and utilize knowledge more efficiently (Lund Vinding, 2006). Firms active in the export market can acquire diverse knowledge inputs that are not available in the domestic market, thereby enhancing their innovative capabilities (Salomon & Shaver, 2005). Therefore, EXPORT is expected to affect firms' product innovation positively. Based on the absorptive capacity perspective, R&D investment not only affects innovation performance directly but also increases firms' abilities to acquire and utilize external knowledge (Cohen & Levinthal, 1990). Thus, R&D is expected to exert a positive effect on innovation. Finally, firms in different sectors are likely to differ in their innovativeness. Firms in the science-based sector tend to innovate more than the other three sectors (Pisano, 2010).

2.3. Analytical method

The primary analysis in this study employs the Negative Binomial Regression (NBR). The NBR is designed to analyze the count dependent variable, as is the case with new product counts used to capture firms' product innovation performance in this study. An alternative to the NBR is the Poisson Regression (PR). However, when the assumption of mean-variance equality is not held, the NBR tends to be more appropriate than the PR (Long, 1997). This assumption is found to be not held in all model specifications, as indicated by the statistical significance of the alpha coefficient (see Table 2), suggesting that the NBR is preferable to the PR (Hardin & Hilbe, 2018).

3. RESULTS

Before running NBR, the multicollinearity among independent variables was checked. In Table 1, bivariate correlations and VIF statistics are displayed. The correlation between BREADTH and BREADTH2 is seemingly high, even after they are mean-centered. However, they are unlikely to cause serious multicollinearity problems, as the VIF statistics are much lower than 10, the threshold at which multicollinearity may cause serious issues in regression estimates (Wooldridge, 2016).

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Table 1. Bivariate correlations and variance inflation factors (VIF) of independent variables in the NBR models

	1	2	3	4	5	6	7	8	9	10	11	12
1. BREADTH	1											
2. BREADTH^2	–0.753[a]	1										
3. DEPTH	.516[a]	–.456[a]	1									
4. DEPTH^2	.116[b]	0.041	.530[a]	1								
5. SIZE	.185[a]	–.147[a]	.208[a]	0.027	1							
6. SKILL	0.089	–.126[a]	.129[a]	0.07	–.122[b]	1						
7. EXPORT	.131[a]	–.137[**]	0.083	–0.07	.429[a]	–0.046	1					
8. R&D	.248[a]	–.221[a]	.277[a]	0.056	.356[a]	.236[a]	.181[a]	1				
9. SECTOR1	–0.022	0.033	0.009	0.049	–0.026	0.036	–.163[a]	0.022	1			
10. SECTOR2	0.001	0.005	–0.034	–0.009	–0.034	–.127[a]	0.03	–0.091	–.547[a]	1		
11. SECTOR3	0.02	–0.039	–0.04	–0.069	0.03	.119[b]	0.08	–0.025	–.204[a]	–.212[a]	1	
12. YOUNG	–0.004	0.000	0.049	0.035	–.289[a]	.159[a]	–.173[a]	–0.078	–0.081	0.047	–0.010	1
VIF	4.128	4.233	2.211	1.701	1.531	1.190	1.290	1.339	1.746	1.724	1.268	1.142

Note: [a] $p < 0.01$; [b] $p < 0.05$.

Table 2 reports the NBR results in five model specifications. Specification 1 includes only control variables and serves as a baseline for the analysis. Specification 2 estimates the interaction effects of BREADTH and YOUNG to see whether search breadth is vital for product innovation for young firms, compared to older firms, thereby testing Hypothesis 1. Specification 3 estimates Hypothesis 3a by including the square term of BREADTH and the interaction term BREADTH*YOUNG, testing whether the curvilinear effect (inverted U-curve pattern) of search breadth on product innovation exists for young firms. In Specification 4, Hypothesis 2 is tested by estimating the interaction effect of DEPTH and YOUNG to assess whether the impact of search depth on innovation is more pronounced for young firms, compared to older firms. Finally, Specification 5 adds the square term of DEPTH together with the interaction term DEPTH*YOUNG to check whether the curvilinear effect (inverted U-curve pattern) of search depth on product innovation exists for young firms, thereby testing Hypothesis 3b.

The first thing to notice is the model summary statistics, which show that the Pseudo-R^2 of model specifications 2–5 increases remarkably from the baseline specification, suggesting that including key variables better explains the variance of the dependent variable. The alpha coefficients are statistically significant for all specifications, indicating that the mean-variance equality assumption is not supported, and hence, the NBR is preferable to the PR.

Specification 2 shows that the coefficients of the YOUNG, BREADTH, and BREADTH*YOUNG variables are positive and statistically significant, although they are moderately significant ($p < 0.10$) for the last two variables. This result suggests that, for young firms, search breadth is a crucial search strategy for improving their product innovation. Thus, the result supports Hypothesis 1, which states that search breadth is essential for the innovation performance of young firms.

In Specification 3, BREADTH^2 is not statistically significant, although YOUNG and BREADTH*YOUNG are still positive and statistically significant. With the insignificance of BREADTH^2, this study cannot establish that the curvilinear effect of search breadth on product innovation exists for young firms. Therefore, this evidence does not support Hypothesis 3a.

Specifications 4 and 5 examine the linear and curvilinear effects of search depth on young firms' innovation, respectively. In Specification 4, it is found that the coefficient of the interaction variable DEPTH*YOUNG is negative and significant ($p < 0.05$), suggesting that search depth tends to hamper young firms' product innovation. This result contradicts Hypothesis 2, which posits that the depth of knowledge search will benefit young firms' innovation.

In Specification 5, it is found that the coefficient of DEPTH is positive and significant ($p < 0.01$), while its square term (DEPTH^2) is negative and significant (p

< 0.01). Additionally, the coefficient of the interaction term DEPTH*YOUNG is negative and significant (p < 0.01). These results indicate that search depth has an inverted U-curve effect on young firms' product innovation, consistent with Hypothesis 3b.

Note also that the effects of YOUNG are positive and statistically significant (p < 0.01) in every model specification, suggesting that young firms in this sample are more likely than older firms to introduce new products into the markets. This result aligns with previous studies suggesting that young and newly established firms tend to adopt a new product development strategy to compete with incumbent firms (Balasubramanian & Lee, 2008; Huergo & Jaumandreu, 2004; Shapiro, 1986).

For control variables, it is shown that the effects of SIZE and R&D are robust, with positive and statistically significant coefficients in all five specifications. Larger firms tend to have more resources for innovative activities that may result in better product innovation performance (Vaona & Pianta, 2008). Similarly, R&D investment indicates firms' in-house knowledge generation and absorptive capacities (Berchicci, 2013; Cohen & Levinthal, 1990). According to Table 1, young firms are generally smaller and invest less in R&D than older firms, which can be regarded as the main disadvantage of young firms. However, as implied by the NBR result in Table 2, young firms may overcome this disadvantage by adopting a search breadth strategy and sourcing external knowledge from various sources.

To supplement the results in Table 2, the simple slope approach is employed, and the key results are presented graphically (Aiken & West, 1991; Dawson, 2014), examining the effects of search breadth/search depth on product innovation conditional on firms' characteristics of being young or older firms, holding other variables constant. Figures 1–3 show the plots based on the results from Specifications 2, 4, and 5. The plot from Specification 3's result is not shown because one of the key variables in this model specification (i.e., BREADTH^2) is not statistically significant.

Figure 1 illustrates the effects of search breadth on the number of new products introduced by young and older firms. As shown, the introduction of

Table 2. NBR results

Variables	Specification1		Specification2		Specification3		Specification4		Specification5	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	–1.428[a]	0.387	–2.159[a]	0.422	–1.955[a]	0.453	–2.193[a]	0.419	–1.706[a]	0.423
SIZE	0.228[a]	0.067	0.319[a]	0.070	0.326[a]	0.070	0.321[a]	0.070	0.299[a]	0.067
SKILL	0.211	0.459	0.423	0.452	0.333	0.459	0.545	0.452	0.651	0.451
EXPORT	0.027	0.078	0.065	0.074	0.059	0.074	0.067	0.073	0.065	0.071
R&D	0.101[a]	0.017	0.100[a]	0.017	0.101[a]	0.017	0.097[a]	0.017	0.092[a]	0.017
SECTOR1 (SECTOR4=0)	1.110[a]	0.290	0.831[a]	0.282	0.872[a]	0.283	0.824[a]	0.281	0.896[a]	0.276
SECTOR2 (SECTOR4=0)	0.762[a]	0.288	0.821[a]	0.282	0.812[a]	0.282	0.804[a]	0.279	0.774[a]	0.276
SECTOR3 (SECTOR4=0)	0.430	0.463	0.362	0.447	0.337	0.450	0.327	0.443	0.248	0.436
YOUNG			1.100[a]	0.331	1.034[a]	0.336	1.243[a]	0.318	1.075[a]	0.306
BREADTH			0.080[c]	0.048	0.005	0.078	0.093[b]	0.046	0.042	0.046
BREADTH^2					–0.025	0.020				
DEPTH			0.060	0.052	0.057	0.052	0.085	0.055	0.224[a]	0.062
DEPTH^2									–0.065[a]	0.017
BREADTH*YOUNG			0.278[c]	0.143	0.272[c]	0.144				
DEPTH*YOUNG							–0.308[b]	0.140	–0.324[a]	0.119
LR Chi–Square (df)	90.50(7)[a]		124.75(11)[a]		126.29(12)[a]		125.44(11)[a]		125.67(12)[a]	
Pseudo–R^2	0.057		0.079		0.080		0.079		0.079	
Alpha coefficient (SE)	3.783(.401)[a]		3.298(.355)[a]		3.281(.353)[a]		3.248(.353)[a]		3.239(.353)	
n	423		423		423		423		423	

Note: [a] p < 0.01; [b] p < 0.05; [c] p < 0.10.

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new products increases as young firms source external knowledge more broadly, while the number of new products stays the same for older firms at all levels of search breadth. Thus, search breadth benefits young firms more than older firms in terms of product innovations. In contrast, Figure 2 shows that while the effect of search depth on older firms' product innovation is positive, the effect on young firms' product innovation tends to be negative. Therefore, search depth may not be a vital strategy for young firms to enhance their product innovation capability. Finally, Figure 3 shows that although the curvilinear effect of search depth on product innovation is present for both groups of firms, it is more pronounced for young firms than for older firms. For young firms, sourcing external knowledge intensively is most efficient when it comes from a single source. Then, as the number of external sources from which knowledge is acquired increases, young firms gain less benefit in terms of product innovation.

In summary, the findings present a differentiated picture of external knowledge search in the context of young firms' innovation. The results confirm the fundamental importance of search breadth (H1 accepted). However, no significant direct relationship was found for search depth

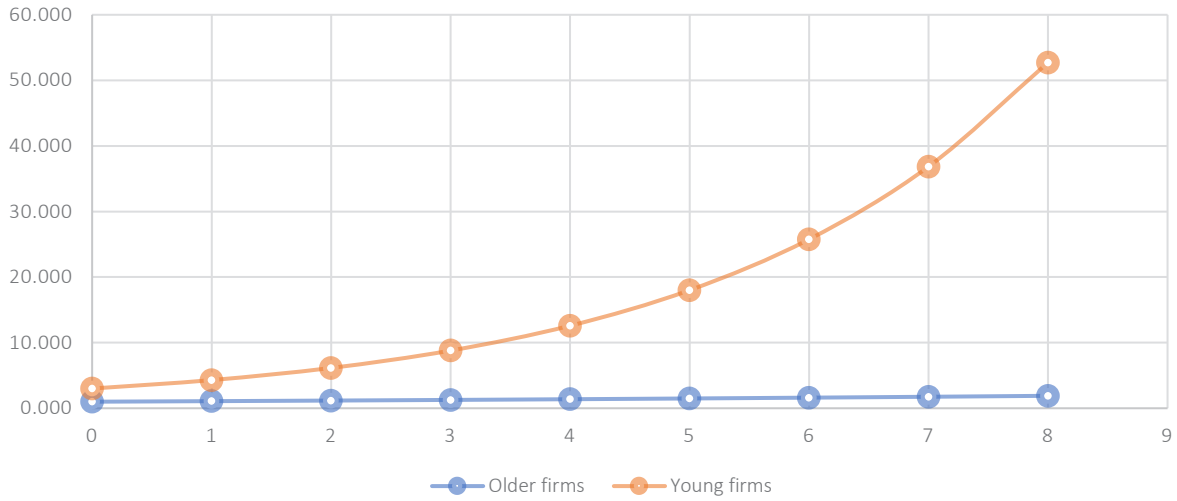

Figure 1. The effects of search breadth on the number of firms' new products – Young firms vs older firms

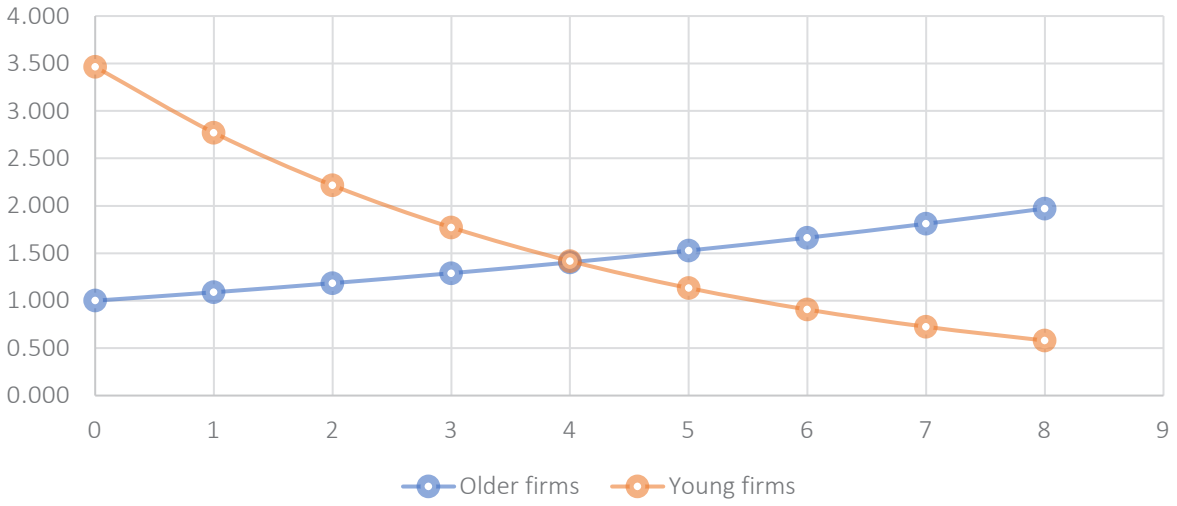

Figure 2. The effects of search depth on the number of firms' new products – Young firms vs older firms

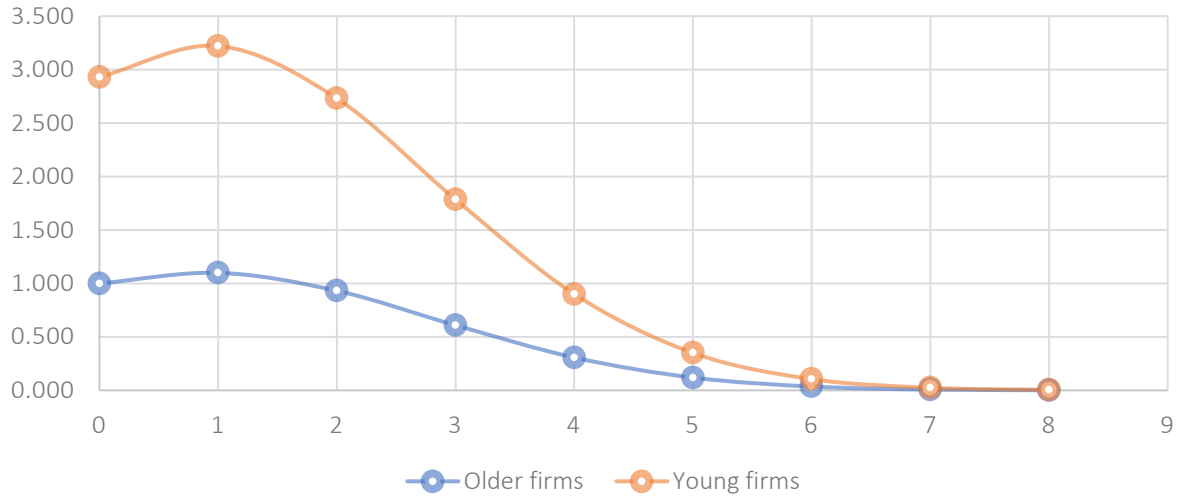

Figure 3. The inverted U-curve effects of search depth on the number of firms' new products – Young firms vs older firms

(H2 rejected). Regarding the curvilinear effects, the data refute an inverted U-shaped relationship for search breadth (H3a rejected) but confirm one for search depth, indicating that excessive depth can diminish returns on innovation performance (H3b accepted).

4. DISCUSSION

The study significantly contributes to the open innovation literature, particularly in the area of open search strategies, by investigating the effects of two dominant open search strategies (search breadth and search depth) on young firms' innovation performance. The open search literature has paid scant attention to young firms, leaving a significant gap in the literature on how these firms can benefit from the breadth or depth of knowledge sourcing. The results presented in this paper not only fill this gap but also challenge some existing assumptions. Specifically, the results reveal that search breadth has a positive effect on firms' product innovation. However, this study does not find a significant inverted U-shape relationship between search breadth and young firms' product innovation performance. Regarding search depth, it is found that depth negatively impacts young firms' product innovation, and the effect of depth exhibits an inverted U-curve pattern. These findings are of utmost importance for young firms, as they provide valuable insights into the strategies that can enhance or hinder innovation performance.

Some theoretical implications can be drawn from the findings of this study. First, young firms generally specialize in a particular technology field with a narrow knowledge base (Hughes et al., 2007). However, to successfully develop and introduce new products into the markets, young firms need to extend their knowledge base by obtaining various information and drawing on a large pool of novel insights. To do so, young firms need to obtain knowledge from various sources. Based on the knowledge combination perspective, the inflow of different knowledge will enlarge the possibility of knowledge recombination, helping firms develop novel ideas and multiple solutions to technical problems (Leiponen & Helfat, 2010; Savino et al., 2017; Xiao et al., 2022).

Additionally, it is argued that many firms adopt open innovation practices because they face resource constraints and cannot rely only on their internal knowledge resources to keep up with rapid technological changes (Chesbrough, 2003). By establishing knowledge interactions with many knowledge actors, firms can tap into rich knowledge networks, enabling knowledge resource complementarity and enhancing firms' innovative capabilities (Kobarg et al., 2019; Nieto & Santamaría, 2007). Moreover, search breadth can also have a vital impact on firms' dynamic learning capabilities. The more firms engage in diverse knowledge networks, the more they benefit from external knowledge-sourcing activities, resulting in increased innovative capabilities (Love et al.,

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2014). This is mainly because when firms interact and source knowledge from many actors, they learn and adjust themselves to different practices, norms, and routines for sourcing knowledge effectively (Kostopoulos et al., 2011), which helps to enhance their absorptive capacity (i.e., the ability to identify relevant external knowledge and to acquire and exploit it). The finding of the positive effect of search breadth on innovation confirms these theoretical arguments.

Second, as opposed to earlier studies (e.g., Chen et al., 2011; Gimenez-Fernandez et al., 2019; Gimenez-Fernandez et al., 2020; Greco et al., 2016; Kobarg et al., 2019; Laursen & Salter, 2006; Xu, 2015), the inverted U-shaped relationship between young firms' search breadth and product innovation is not established in this study. According to earlier studies, for young firms with limited resources and business experience, acquiring knowledge from multiple external sources means they must spread their resources across different search channels, each characterized by a specific institutional setting, which requires different managerial practices and routines for knowledge acquisition (Laursen & Salter, 2006). In this sense, when young firms search for knowledge from too many sources, the managerial costs of external knowledge acquisition increase, leading to resource exhaustion and the ineffectiveness of knowledge sourcing. As argued by some scholars (Laursen & Salter, 2006; Ocasio, 1997), one of the essential resources in external knowledge acquisition is the attention of firm managers, which is most efficient when focused and directed toward specific issues. When young firms choose to source knowledge from various actors, managers tend to focus their attention on only some sources, making knowledge sourcing from those sources less effective.

Additionally, Radicic (2021) and Xu (2015) argue that when firms extend their knowledge-sourcing activities across a wide range of sources, they must increase their absorptive capacity to ensure that acquired knowledge will be effectively exploited. Consequently, firms' resources, which are integral parts of absorptive capacities, e.g., R&D and human resources (Cohen & Levinthal, 1990; Lund Vinding, 2006), must be increased; otherwise, increasing search breadth will lead to absorptive capacity exhaustion and inefficient knowledge sourcing. However, these resources are limited for young firms, and doubling them is difficult. Thus, the effect of search breadth on innovation can become negative if the search exceeds the optimal level.

However, given that the square term of search breadth is statistically insignificant, the inverted U-curve effect of breadth on young firms' innovation cannot be established by this study. Nevertheless, it should be noted that the variable BREADTH has a range between zero and eight external knowledge sources. It is possible that the curvilinear effect of breadth may not be present within this range, but could occur beyond that. Unfortunately, due to data limitations, it is not possible to address this issue in this study.

Third, this study demonstrates that search depth hurts young firms' product innovation. Several studies use various innovation measures to investigate the effects of search depth on firms' innovation performance (Chen et al., 2011; Greco et al., 2016; Kobarg et al., 2019; Laursen & Salter, 2006). However, no research has particularly focused on young firms. The current study is the first to investigate the impact of search depth on the innovation performance of young firms. One of the most prominent advantages of the search depth strategy is that it is grounded in intensive interactions, close ties, and trust-based relationships between firms and their knowledge partners, which are necessary for transferring tacit and complex technological knowledge (Kobarg et al., 2019). However, the findings in this study do not conform to this argument. It is likely that when young firms acquire knowledge intensively from limited knowledge sources, their innovation improvement is inhibited. According to Laursen and Salter (2006) and Leonard-Barton (1992), when firms devote their efforts to acquiring knowledge heavily from a few sources and building up their expertise in particular knowledge domains, they tend to pay little attention to exploring technological possibilities in other areas. In the long run, technological advances in other areas may make their core technological competency obsolete (Hughes et al., 2007). This is especially relevant for young firms with a narrow knowledge base. Repeatedly using the same knowledge elements may reduce the possibility

of combining novel pieces of information to generate new knowledge (Xu, 2015).

Finally, this study also finds the inverted U-curve pattern in the relationship between search depth and young firms' product innovation. This finding confirms the above argument that intensively sourcing knowledge can limit young firms' innovation ability. According to Laursen and Salter (2006), search depth requires firms to engage in long-term and intensive relationships with external knowledge actors, which demands considerable resources and attention devoted to knowledge acquisition. Consequently, maintaining long-term and intensive relationships with too many actors may exhaust resources and attention, making search depth less efficient. This issue is likely to occur in young firms with limited resources, as demonstrated in the current study's findings.

The current study also offers managerial implications. The finding suggests that search breadth is vital for young firms' product innovation. Thus, managers of young firms should pursue a broad search strategy and establish knowledge interactions with various knowledge actors to keep bringing in novel ideas. However, young firms must be cautious when seeking a search-depth strategy, primarily by establishing intensive and long-term relationships with some knowledgeable actors. This strategy may limit the opportunity for young firms to explore new and diverse ideas, which are essential for enhancing their ability to introduce innovative products.

CONCLUSION

The purpose of this study is to investigate the impact of two open search strategies (i.e., search breadth and search depth) on young firms' innovation performance (i.e., product innovation). The open innovation literature has initially focused on large and established companies, and empirical studies investigating the effects of open search on firms' innovation performance have paid little attention to young firms. Young firms face several limitations, particularly in terms of resource constraints and a lack of business experience. Thus, they tend to rely on open search strategies to complement their innovative activities. This study aims to fill the existing literature gap and examine which search strategy (search breadth or search depth) is more crucial for the innovation performance of young firms.

The survey data from 423 manufacturing firms in Thailand were used to examine how search breadth and depth affect product innovation in young firms. The results from the negative binomial regression indicate that search breadth enhances the product innovation performance of young firms, while search depth hampers it. It is also found that there is an inverted U-shape relationship between search depth and firms' innovation, suggesting that the benefit of search depth tends to diminish as the degree of external knowledge search increases. Overall, the results indicate that young firms, provided they have limited resources, should adopt a search breadth strategy and source knowledge broadly from various actors, rather than establishing long-term relationships and sourcing knowledge intensively from a few actors.

It is worth noting that the current study has notable limitations. First, it is based on the cross-sectional dataset. This dataset cannot be used to estimate the dynamic effects of search breadth and search depth on the innovation performance of young firms. For instance, the finding that breadth is positive and depth is negative on young firms' product innovation may depend on the industry life cycle of firms (Laursen & Salter, 2006). However, the current analysis based on cross-sectional data cannot capture this issue. Future research should focus on the dynamic effects of search breadth and depth using panel data to investigate the impact of these variables on outcomes. Second, firms' innovation performance is measured using only the market introduction of new products. However, search breadth and search depth may also have a profound impact on process or marketing innovations. Future research may fill this gap by investigating the effects of breadth and depth on the processes and marketing innovations of young firms.

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Writing – review & editing: Phakpoom Tippakoon.

REFERENCES

1. Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Sage Publications, Inc.
2. Antolín-López, R., Céspedes-Lorente, J., García-de-Frutos, N., Martínez-del-Río, J., & Pérez-Valls, M. (2015). Fostering product innovation: Differences between new ventures and established firms. *Technovation, 41-42,* 25-37. https://doi.org/10.1016/j.technovation.2015.02.002
3. Arundel, A., & Kabla, I. (1998). What percentage of innovations are patented? Empirical estimates for European firms. *Research Policy, 27*(2), 127-141. https://doi.org/10.1016/S0048-7333(98)00033-X
4. Balasubramanian, N., & Lee, J. (2008). Firm age and innovation. *Industrial and Corporate Change, 17*(5), 1019-1047. https://doi.org/10.1093/icc/dtn028
5. Barbieri, N., Marzucchi, A., & Rizzo, U. (2020). Knowledge sources and impacts on subsequent inventions: Do green technologies differ from non-green ones? *Research Policy, 49*(2), Article 103901. https://doi.org/10.1016/j.respol.2019.103901
6. Berchicci, L. (2013). Towards an open R&D system: Internal R&D investment, external knowledge acquisition and innovative performance. *Research Policy, 42*(1), 117-127. https://doi.org/10.1016/j.respol.2012.04.017
7. Borgatti, S. P., & Cross, R. (2003). A relational view of information seeking and learning in social networks. *Management Science, 49*(4), 432-445. https://doi.org/10.1287/mnsc.49.4.432.14428
8. Bruneel, J., Yli-Renko, H., & Clarysse, B. (2010). Learning from experience and learning from others: How congenital and interorganizational learning substitute for experiential learning in young firm internationalization. *Strategic Entrepreneurship Journal, 4*(2), 164-182. https://doi.org/10.1002/sej.89
9. Caloghirou, Y., Kastelli, I., & Tsakanikas, A. (2004). Internal capabilities and external knowledge sources: Complements or substitutes for innovative performance? *Technovation, 24*(1), 29-39. https://doi.org/10.1016/S0166-4972(02)00051-2
10. Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science, 52*(1), 68-82. https://doi.org/10.1287/mnsc.1050.0470
11. Chandler, G.N., & Lyon, D.W. (2009). Involvement in knowledge–acquisition activities by venture team members and venture performance. *Entrepreneurship Theory and Practice, 33*(3), 571-592. https://doi.org/10.1111/j.1540-6520.2009.00317.x
12. Chen, J., Chen, Y., & Vanhaverbeke, W. (2011). The influence of scope, depth, and orientation of external technology sources on the innovative performance of Chinese firms. *Technovation, 31*(8), 362-373. https://doi.org/10.1016/j.technovation.2011.03.002
13. Chesbrough, H. (2017). The future of open innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants. *Research-Technology Management, 60*(1), 35-38. https://doi.org/10.1080/08956308.2017.1255054
14. Chesbrough, H.W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business School Press.
15. Chesbrough, H.W., Vanhaverbeke, W., & West, J. (Eds.). (2006). *Open innovation: Researching a new paradigm*. Oxford University Press.
16. Chiang, Y. H., & Hung, K. P. (2010). Exploring open search strategies and perceived innovation performance from the

perspective of inter-organizational knowledge flows. *R&D Management, 40*(3), 292-299. https://doi.org/10.1111/j.1467-9310.2010.00588.x

17. Choi, D. S., Sung, C. S., & Park, J. Y. (2020). How does technology startups increase innovative performance? The study of technology startups on innovation focusing on employment change in Korea. *Sustainability, 12*(2). https://doi.org/10.3390/su12020551

18. Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128-152. Retrieved from https://josephmahoney.web.illinois.edu/BA545_Fall%202022/Cohen%20and%20Levinthal%20(1990).pdf

19. Dawson, J. F. (2014). Moderation in management research: What, why, when, and how. *Journal of Business and Psychology, 29*(1), 1-19. https://doi.org/10.1007/s10869-013-9308-7

20. Doloreux, D., Turkina, E., & Van Assche, A. (2019). Innovation type and external knowledge search strategies in KIBS: Evidence from Canada. *Service Business, 13*(3), 509-530. https://doi.org/10.1007/s11628-018-00393-y

21. Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review, 23*(4), 660-679. https://doi.org/10.5465/amr.1998.1255632

22. Ferreras-Méndez, J. L., Fernández-Mesa, A., & Alegre, J. (2016). The relationship between knowledge search strategies and absorptive capacity: A deeper look. *Technovation, 54,* 48-61. https://doi.org/10.1016/j.technovation.2016.03.001

23. Ferreras-Méndez, J. L., Newell, S., Fernández-Mesa, A., & Alegre, J. (2015). Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity. *Industrial Marketing Management, 47,* 86-97. https://doi.org/10.1016/j.indmarman.2015.02.038

24. Flor, M. L., Cooper, S. Y., & Oltra, M. J. (2018). External knowledge search, absorptive capacity and radical innovation in high-technology firms. *European Management Journal, 36*(2), 183-194. https://doi.org/10.1016/j.emj.2017.08.003

25. Friesl, M. (2012). Knowledge acquisition strategies and company performance in young high technology companies. *British Journal of Management, 23*(3), 325-343. https://doi.org/10.1111/j.1467-8551.2011.00742.x

26. Gimenez-Fernandez, E. M., Bogers, M., & Sandulli, F. (2019). How the diversity of cooperation partners affects startups' innovation performance: An analysis of the role of cooperation breadth in open innovation. In G. Rexhepi, R.D. Hisrich, & V. Ramadani (Eds.), *Open Innovation and Entrepreneurship: Impetus of Growth and Competitive Advantages* (pp. 9-35). Springer. https://doi.org/10.1007/978-3-030-16912-1_2

27. Gimenez-Fernandez, E.M., Sandulli, F. D., & Bogers, M. (2020). Unpacking liabilities of newness and smallness in innovative startups: Investigating the differences in innovation performance between new and older small firms. *Research Policy, 49*(10), Article 104049. https://doi.org/10.1016/j.respol.2020.104049

28. Gray, C. (2006). Absorptive capacity, knowledge management and innovation in entrepreneurial small firms. *International Journal of Entrepreneurial Behaviour & Research, 12*(6), 345-360. https://doi.org/10.1108/13552550610710144

29. Greco, M., Grimaldi, M., & Cricelli, L. (2016). An analysis of the open innovation effect on firm performance. *European Management Journal, 34*(5), 501-516. https://doi.org/10.1016/j.emj.2016.02.008

30. Guo, B., & Wang, Y. (2014). Environmental turbulence, absorptive capacity and external knowledge search among Chinese SMEs. *Chinese Management Studies, 8*(2), 258-272. https://doi.org/10.1108/CMS-03-2014-0051

31. Hardin, J. W., & Hilbe, J. M. (2018). *Generalized linear models and extensions*. Stata Press.

32. Huergo, E., & Jaumandreu, J. (2004). How does probability of innovation change with firm age? *Small Business Economics, 22,* 193-207. https://doi.org/10.1023/B:SBEJ.0000022220.07366.b5

33. Hughes, M., Hughes, P., & Morgan, R. E. (2007). Exploitative learning and entrepreneurial orientation alignment in emerging young firms: Implications for market and response performance. *British Journal of Management, 18*(4), 359-375. https://doi.org/10.1111/j.1467-8551.2007.00519.x

34. Kobarg, S., Stumpf-Wollersheim, J., & Welpe, I. M. (2019). More is not always better: Effects of collaboration breadth and depth on radical and incremental innovation performance at the project level. *Research Policy, 48*(1), 1-10. https://doi.org/10.1016/j.respol.2018.07.014

35. Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. *Journal of Business Research, 64*(12), 1335-1343. https://doi.org/10.1016/j.jbusres.2010.12.005

36. Kraus, S., Kailer, N., Dorfer, J., & Jones, P. (2020). Open innovation in (young) SMEs. *The International Journal of Entrepreneurship and Innovation, 21*(1), 47-59. https://doi.org/10.1177/1465750319840778

37. Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal, 27*(2), 131-150. https://doi.org/10.1002/smj.507

38. Leiponen, A., & Helfat, C. E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal, 31*(2), 224-236. https://doi.org/10.1002/smj.807

39. Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic*

http://dx.doi.org/10.21511/ppm.23(3).2025.39

Management Journal, 13(S1), 111-125. https://doi.org/10.1002/smj.4250131009

40. Li, H. (2022). Effects of innovation modes and network partners on innovation performance of young firms. *European Journal of Innovation Management, 25*(5), 1288-1308. https://doi.org/10.1108/EJIM-12-2020-0511
41. Long, S.J. (1997). *Regression models for categorical and limited dependent variables*. SAGE Publications.
42. Love, J. H., Roper, S., & Vahter, P. (2014). Learning from openness: The dynamics of breadth in external innovation linkages. *Strategic Management Journal, 35*(11), 1703-1716. https://doi.org/10.1002/smj.2170
43. Lund Vinding, A. (2006). Absorptive capacity and innovative performance: A human capital approach. *Economics of Innovation and New Technology, 15*(4-5), 507-517. https://doi.org/10.1080/10438590500513057
44. Marion, T. J., Friar, J. H., & Simpson, T. W. (2012). New product development practices and early-stage firms: Two in-depth case studies. *Journal of Product Innovation Management, 29*(4), 639-654. https://doi.org/10.1111/j.1540-5885.2012.00930.x
45. Martini, A., Aloini, D., & Neirotti, P. (2012). Degree of openness and performance in the search for innovation. *International Journal of Engineering Business Management, 4*, 4-37. https://doi.org/10.5772/54752
46. Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1998). Technological overlap and interfirm cooperation: Implications for the resource-based view of the firm. *Research Policy, 27*(5), 507-523. https://doi.org/10.1016/S0048-7333(98)00066-3
47. Nelson, R. R., & Winter, S. G. (1982). The Schumpeterian tradeoff revisited. *The American Economic Review, 72*(1), 114-132. Retrieved from https://ideas.repec.org/a/aea/aecrev/v72y1982i1p114-32.html
48. Nieto, M. J., & Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation, 27*(6-7), 367-377. https://doi.org/10.1016/j.technovation.2006.10.001
49. Noori, J., Nasrabadi, M. B., Yazdi, N., & Babakhan, A. R. (2017). Innovative performance of Iranian knowledge-based firms: Large firms or SMEs? *Technological Forecasting and Social Change, 122,* 179-185. https://doi.org/10.1016/j.techfore.2016.04.025
50. Ocasio, W. (1997). Towards an attention-based view of the firm. *Strategic Management Journal, 18*(S1), 187-206. https://doi.org/10.1002/(SICI)1097-0266(199707)18:1+<187::AID-SMJ936>3.0.CO;2-K
51. Pangarkar, N., & Wu, J. (2013). Alliance formation, partner diversity, and performance of Singapore startups. *Asia Pacific Journal of Management, 30,* 791-807. https://doi.org/10.1007/s10490-012-9305-9
52. Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy, 13*(6), 343-373. https://doi.org/10.1016/0048-7333(84)90018-0
53. Pisano, G. P. (2010). The evolution of science-based business: Innovating how we innovate. *Industrial and Corporate Change, 19*(2), 465-482. https://doi.org/10.1093/icc/dtq013
54. Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12*(4), 531-544. https://doi.org/10.1177/014920638601200408
55. Protogerou, A., Caloghirou, Y., & Vonortas, N. S. (2017). Determinants of young firms' innovative performance: Empirical evidence from Europe. *Research Policy, 46*(7), 1312-1326. https://doi.org/10.1016/j.respol.2017.05.011
56. Radicic, D. (2021). Breadth of external knowledge search in service sectors. *Business Process Management Journal, 27*(1), 230-252. https://doi.org/10.1108/BPMJ-01-2020-0018
57. Rodriguez, M., Doloreux, D., & Shearmur, R. (2017). Variety in external knowledge sourcing and innovation novelty: Evidence from the KIBS sector in Spain. *Technovation, 68,* 35-43. https://doi.org/10.1016/j.technovation.2017.06.003
58. Salomon, R. M., & Shaver, J. M. (2005). Learning by exporting: New insights from examining firm innovation. *Journal of Economics & Management Strategy, 14*(2), 431-460. https://doi.org/10.1111/j.1530-9134.2005.00047.x
59. Sampson, R. C. (2004). Organizational choice in R&D alliances: Knowledge-based and transaction cost perspectives. *Managerial and Decision Economics, 25*(6-7), 421-436. https://doi.org/10.1002/mde.1199
60. Savino, T., Messeni Petruzzelli, A., & Albino, V. (2017). Search and recombination process to innovate: A review of the empirical evidence and a research agenda. *International Journal of Management Reviews, 19*(1), 54-75. https://doi.org/10.1111/ijmr.12081
61. Shapiro, N. (1986). Innovation, new industries and new firms. *Eastern Economic Journal, 12*(1), 27-43. Retrieved from https://www.jstor.org/stable/40357381
62. Tamer Cavusgil, S., Calantone, R. J., & Zhao, Y. (2003). Tacit knowledge transfer and firm innovation capability. *Journal of Business & Industrial Marketing, 18*(1), 6-21. https://doi.org/10.1108/08858620310458615
63. Terjesen, S., & Patel, P. C. (2017). In search of process innovations: The role of search depth, search breadth, and the industry environment. *Journal of Management, 43*(5), 1421-1446. https://doi.org/10.1177/0149206315575710
64. Tether, B. S. (2005). Do services innovate (differently)? Insights from the European innobarometer survey. *Industry & Innovation, 12*(2), 153-184. https://doi.org/10.1080/13662710500087891

65. Vaona, A., & Pianta, M. (2008). Firm size and innovation in European manufacturing. *Small Business Economics, 30,* 283-299. https://doi.org/10.1007/s11187-006-9043-9

66. Visser, E. J., & Boschma, R. (2004). Learning in districts: Novelty and lock-in in a regional context. *European Planning Studies, 12*(6), 793-808. https://doi.org/10.1080/0965431042000251864

67. Wang, C., Brunswicker, S., & Majchrzak, A. (2021). Knowledge search breadth and depth and OI projects performance: A moderated mediation model of control mechanism. *Journal of Knowledge Management, 25*(4), 847-870. https://doi.org/10.1108/JKM-03-2020-0222

68. Wooldridge, J. M. (2016). *Introductory economics: A modern approach*. Cengage Learning.

69. Xiao, T., Makhija, M., & Karim, S. (2022). A knowledge recombination perspective of innovation: Review and new research directions. *Journal of Management, 48*(6), 1724-1777. https://doi.org/10.1177/01492063211055982

70. Xu, S. (2015). Balancing the two knowledge dimensions in innovation efforts: An empirical examination among pharmaceutical firms. *Journal of Product Innovation Management, 32*(4), 610-621. https://doi.org/10.1111/jpim.12234

71. Ye, J., Jiang, Y., Hao, B., & Feng, Y. (2023). Knowledge search strategies and corporate entrepreneurship: Evidence from China's high-tech firms. *European Journal of Innovation Management, 26*(2), 564-587. https://doi.org/10.1108/EJIM-02-2021-0111

72. Yli-Renko, H., Autio, E., & Sapienza, H. J. (2001). Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal, 22*(6-7), 587-613. https://doi.org/10.1002/smj.183

73. Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review, 27*(2), 185-203. Retrieved from https://journals.aom.org/doi/10.5465/AMR.2002.6587995

74. Zang, J., Zhang, C., Yang, P., & Li, Y. (2014). How open search strategies align with firms' radical and incremental innovation: Evidence from China. *Technology Analysis & Strategic Management, 26*(7), 781-795. https://doi.org/10.1080/09537325.2014.899345

75. Zheng, S., Li, H., & Wu, X. (2013). Network resources and the innovation performance: Evidence from Chinese manufacturing firms. *Management Decision, 51*(6), 1207-1224. https://doi.org/10.1108/MD-02-2012-0102

76. Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: Knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal, 33*(9), 1090-1102. https://doi.org/10.1002/smj.1959

http://dx.doi.org/10.21511/ppm.23(3).2025.39