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R&D support, technological turbulence, and SMEs' degree of internationalization: The mediating role of technological capability

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Abstract

This article examines the role of R&D support in the degree of internationalization through the mediating mechanism of technological capability. We also investigate the moderating role of technological turbulence in the relationship between R&D support and technological capability. Using primary data collected from 227 firms engaged in cross-border activities, and employing moderated mediation analysis, the results show that R&D support positively relates to technological capability, and this relationship is moderated by technological turbulence. Moreover, the impact of R&D support on firms' degree of internationalization is mediated by technological capability. The findings from the study provide implications for IB theory and practice.

KEYWORDS
Africa, Ghana, internationalization, R&D support, SMEs, technological capability

1 | INTRODUCTION

The factors accounting for developing countries firms' ability to embark on cross-border activities have attracted substantial interest in international business (IB) literature (Adomako, Opoku, & Frimpong, 2017; Boehe, 2013; Zhang, Ma, Wang, Li, & Huo, 2016). The existing stream of research has examined both internal organization drivers (McDougall & Oviatt, 1991; Yiu, Lau, & Bruton, 2007) and external drivers (Gammeltoft, Barnard, & Madhok, 2010; Shirokova & Tsukanova, 2013) of firm internationalization. For example, the literature on foreign direct investment argues firm-specific ownership advantages influence the degree to which firms internationalize (Yiu et al., 2007). Additionally, some studies have indicated that country institutional factors influence firms' internationalization process (Townsend & Hart, 2008).

Despite the growing body of research, the current literature exhibits some vital knowledge gaps. First, despite the literature on how governments can foster business development, growth and expansion (Adams, Debrah, Williams, & Mmieh, 2014; Korhonen, Luostarinen, & Welch, 1996), theoretical exposition of how government support such as R&D investment drives the degree to which small to medium enterprises (SMEs) internationalize in resource-constrained settings remains limited. In developing countries, governments are considered important contextual influencers of firm behavior (Bruton & Lau, 2008; Malik & Kotabe, 2009). Governments in developing countries assist small firms in R&D funding to build their technological expertise to identify, select and implement new technologies (Mazzoleni & Nelson, 2007). Extant research suggests that failure of governments to help private firms to innovate could lead to leakages and spillovers that reduce firms' return on investment and hinder R&D activities (Kang & Park, 2012). Despite the clear justification for government support for small firms to involve themselves in R&D activities, how government support initiatives impact the international expansion of SMEs in developing countries is less understood.

Second, previous research has established that SMEs with superior technological capabilities tend to internationalize (Mudalige, Ismail, & Malek, 2019; Saarenketo, Puumalainen, Kuivalainen, & Kyläheiko, 2004; Tiessen, Wright, & Turner, 2001). For example, small information and communication technology (ICT) companies are often characterized by early internationalization, which suggests that they internationalize more rapidly than their counterparts (Cannone & Ughetto, 2014; Saarenketo et al., 2004). To develop innovation capability, firms are required to invest in technological capabilities to enable them to acquire skills and resources needed to compete in both domestic and international markets (Zhou & Wu, 2010). As developing countries' small firms adopt new technologies to improve their competitive position in the international market, R&D support is likely to aid them develop appropriate technologies. This is because government funding in the form of R&D support can help small firms put together team of scientists to carry out R&D activities (Malik & Kotabe, 2009). However, lacking in the current literature is a deep insight into the potential mediating role of technological capability in R&D support—internationalization nexus.

Third, prior IB literature has refrained from examining the boundary conditions of the R&D support—technological capability relationship. Accordingly, this article closes this gap by identifying the degree of technological turbulence to explain when support for R&D is linked to technological turbulence.

Consequently, this research intends to examine the impact of the use of R&D support in driving internationalization and study the mediating effect of this association. Moreover, we clarify the R&D support—technological capability nexus by examining the moderating effects of technological turbulence. We attempt to achieve this by drawing insights from the strategy tripod view espoused in previous studies (Peng, Sun, Pinkham, & Chen, 2009; Peng, Wang, & Jiang, 2008) to test a conceptual model on the association between R&D support and degree of internationalization while controlling for pertinent variables. Additionally, this article clarifies the conditions under which R&D support is pronounced in technological capability building.

This research contributes to the IB literature in three ways. First, it extends the literature on firm internationalization (Deng & Zhang, 2018; Li & Xie, 2016; Shamsuddoha, Ali, & Ndubisi, 2009) by showing the critical role played by R&D support. This is an important enquiry because, despite the substantial research efforts focusing on government support in the internationalization process of SMEs (Catanzaro, Messeghem, & Sammut, 2019; Descotes, Walliser, Holzmüller, & Guo, 2011; Hashim, 2012), very limited attention has been given to exploring how R&D activities increase the degree to which SMEs pursue internationalization.

Second, our research examines the mediating effect of technological capability in the association between R&D support and firm internationalization. In this way, the article extends the current understanding of mechanisms through which R&D support influences internationalization. This analysis is critical because it sheds lights on the mechanism through which government support affects the internationalization of firms.

Third, this article advances the current IB literature (Tan & Sousa, 2019; Tihanyi, Hoskisson, Johnson, & Wan, 2009) by exploring the circumstances under which the proposed predictor of technological capability may be more pronounced or otherwise. The strategy tripod view was used to explore the moderating influence of one important situational variable—technological turbulence between R&D support and technological capability. This moderation analysis is an important contribution because the literature fails to highlight the boundary conditions of the link between R&D support and technological capability.

The rest of the article is organized as follows. In the following section, we review the literature on the international business strategy tripod perspective. This is followed by the research method, encompassing insights on the research setting, nature of sample and approaches to data collection. We then set out the analysis and findings of the study. The final section is devoted to discussions and implications for theory and practice.

2 | THEORETICAL BACKGROUND AND HYPOTHESES

2.1 | The strategy tripod perspective

This article adopts the strategy tripod perspective advocated by Peng et al. (2008, 2009) to explain the conceptual model. This theoretical view has been adopted in many empirical studies to explain the drivers of firms' internationalization decisions in the international business field (Gao, Murray, Kotabe, & Lu, 2010; Peng et al., 2008, 2009). The strategy tripod view puts together three competing perspectives in strategy (i.e., institution-based, resource-based and industry-based perspectives). Specifically, in the areas of developing countries, researchers have suggested that the tripod's concept is critical in understanding the strategic decisions of firms (Barin Cruz, Boehe, & Ogasavara, 2015; Khanna & Yafeh, 2007). We contend that institutions matter in understanding SMEs' degree of internationalization in a sense that they determine "the rules of the game in a society" that govern firms' actions and inactions (North, 1990, p. 3). Thus, institutions can act as facilitator or obstacle in firms' internationalization activities. Hence, institutional change or upheavals can spur firms to undertake different ranges of innovation activities and growth (Amankwah-Amoah, 2021).

This overarching theoretical framework is important for the strategic decision process because it has overcome the limitations presented by both the resource-based perspective and industry-based perspective. For example, the industry-based perspective suggests that different industry-specific conditions/factors such as competition and market demand affect a firm's competitive position and performance (Porter, 1985). However, the resource-based perspective contends that a firm's competitive advantage is influenced by the development and deployment of firm-specific unique resources and capabilities (Barney, 1991). While both concepts have advanced our understanding of the sources of a firm's competitiveness, they ignore the impact of the institutional environment (e.g., support from the government). In particular, both perspectives take for granted the critical factors that institutional environment plays in transitional economies. Given the nature of precarious institutional settings in these economies, such as the weak and under-developed institutional infrastructures (Peng et al., 2008, 2009; Sheng, Zhou, & Li, 2011), the adoption of the strategy tripod in this article is justified in considering the SME internationalization process. Thus, understanding how the three perspectives that form the tripod view influence strategic decision-making represents a step forward in the internationalization literature (Peng et al., 2008).

Generally, institutions are classified as "rules of the game in a society" (North, 1990, p. 3). Firms operate well in a very conducive environment, permitting them access to critical resources that promote business activities. Institutions are classified as *informal* (code of conduct) and *formal* (legal) frameworks (North, 1990). The institutional environment serves as an enabler or constrainer of business activities in that specific location (Boettke & Coyne, 2009; Dimaggio & Powell, 1983; Welter & Smallbone, 2011). Thus, well-organized and structured institutions serve as enablers for firm and entrepreneurial activities.

The strategy tripod view suggests that firm resources and capabilities, institutional environment and industry conditions jointly influence firms' performance and strategic choice (Peng et al., 2008, 2009). Based on this argument, we used this theoretical lens to argue that institutional support in the form of R&D accounts for firms' technological capability, which in turn predicts the propensity for SMEs in developing economies to internationalize. In keeping with recent and established research, we consider that the technology capability of SMEs is a firm-level capability and thus is classified under the resource-based perspective. Additionally, we integrate technological turbulence in the industry as a moderating factor that impacts the use of the R&D support—technological capability relationship. Next, we conceptually link the independent and mediating variables to a firm's degree of internationalization.

2.2 | SMEs' technological capability and R&D support

R&D support reflects government-financed R&D investment received by private firms from government agencies to identify, develop and deploy appropriate technologies for business growth (Mazzoleni & Nelson, 2007). For example, in Ghana, the GRATIS Foundation provides small firms with capacity through appropriate technology. This support is justified because failure to improve firm innovation reduces private R&D activities (Arrow, 1962; Kang & Park, 2012). We contend that government involvement in private firms' R&D development can increase their technological capabilities. First, government support in the form of grants, tax incentives and subsidies could boost R&D activities (Romijn & Albaladejo, 2002; Souitaris, 2002). Thus, a developing country's government can encourage firms to build strong technological capabilities by enabling R&D projects with the possibility of creating high revenue (Feldman & Kelley, 2006).

Second, SME managers in developing countries may not be aware of better technology options due to information asymmetries (Malik & Kotabe, 2009). Government support for R&D through its agencies can help in this process using higher government resources. SME managers may also not be willing to experiment with technologies due to their requirements in terms of changes to the firm routines and the costs of acquiring and implementing these technologies (David, 1986; Feldman & Rafaeli, 2002). R&D support can help reduce the cost and uncertainties associated with newer technologies. Moreover, support for R&D activities can help SMEs build strong technological expertise as government agencies supporting R&D activities can bring in superior scientists and technologists funded by government resources. Given that SMEs may not have the required resources to attract such talents, R&D support is crucial for technological capability building. Based on the foregoing arguments, this article suggests that:

> **Hypothesis 1 (H1).** *R&D support has a positive association on SMEs' technological capability*.

2.3 | Moderating effect of technological turbulence

Importantly, the article examines the conditions under which the use of R&D support influences technological capability. Accordingly, we studied the role of technological turbulence in this relationship. Technological turbulence denotes the degree to which technology alters over time to influence and affect industry conditions (Pérez-Nordtvedt, Mukherjee, & Kedia, 2015, p. 25). Technological turbulence unleashes a host of unpredictable external factors in the way the business conducts its activities (Slater & Narver, 1994) as well as amplifying the complexities linked to markets (Arora, Fosfuri, & Gambardella, 2001). Past studies have demonstrated that technological turbulence unleashes rapid change in how technology is adopted and utilized (Lee, Chen, Kim, & Johnson, 2008). This demands flexibility in the approaches adopted as well as a more rapid response to ensure effective alignment with market and consumer requirements (Jaworski & Kohli, 1993; Pérez-Nordtvedt et al., 2015). The changing technological landscape requires government support to be continually upgraded to enable it to remain impactful in enhancing firms' capacity and capabilities. In a highly technologically turbulent environment, a higher level of strategic flexibility is demanded in terms of updating and upgrading to capabilities necessary in the new environment (Terawatanavong, Whitwell, Widing, & O'Cass, 2011). Technological turbulence is likely to demand a different range of government support in fortifying any potential association between R&D support and technological capability. Such an approach can buffer against environmental uncertainty (Terawatanavong et al., 2011). Given also that high technological turbulence often precipitates a precipitous decline in the value of existing technologies as they are superseded by superior new ones (Amankwah-Amoah, 2017), government support could be rendered ineffective if it fails to consider technological turbulence. We contend that technological turbulence will positively moderate the relationship between government R&D support and technological capability. Therefore, we propose that:

Hypothesis 2 (H2). *The association between R&D and technological capability is positively moderated by technological turbulence.*

2.4 | R&D support, technological capability, and internationalization

In H3, we argue that technological capability mediates the link between R&D support and degree of internationalization. This article focuses on the technological capability of SMEs because it is widely viewed as a critical component of competitive advantage and market power in the IB literature (Hymer, 1976; Yiu et al., 2007). The IB literature shows that firms with greater technological capabilities are more likely to engage in international market activities (Dunning, 1993; Hennart & Park, 1993; Tallman & Fladmoe-Lindquist, 2002). Additionally, firms with greater technological capabilities can integrate knowledge from multiple countries (Frost & Zhou, 2005). The IB research shows that multinational companies in developing countries can appropriate, adapt and transform secondary technologies to enable them to strategically position themselves in the global market (Pananond & Zeithaml, 1998).

Given that the adoption of R&D support relates to technological capability, which in turn leads to the degree of internationalization, we postulate that technological capability mediates the relationship between R&D support and SMEs' internationalization. This is because the use of R&D support can help reduce the costs involved in acquiring new technologies for internationalized SMEs. As a firm's technological capability is developed over time (Zhou & Wu, 2010), the use of support can facilitate job opportunities related to various technical resources (Afuah, 2002) to help in the internationalization process. Thus, this article proposes that:

Hypothesis 3 (H3). *Technological capability mediates the association between R&D support and degree of internationalization.*

3 | METHODOLOGY

3.1 | Study setting, sample, and data collection

Our hypotheses were tested with a sample of internationalized SMEs from Ghana, an emerging economy. The choice of the study context was informed by two decisions. First, Ghana has chalked up several successes in terms of reforms of its industrial sectors and markets, and growth of its economy (Adomako, Amankwah-Amoah, Dankwah, Danso, & Donbesuur, 2019). State-controlled businesses and involvement in industrial regulations have been scaled down coupled with additional support for regional industrial hubs and factories (Amankwah-Amoah, 2016). Second, SMEs in Ghana have attained some of the trappings of internationalization, specifically their presence in the Economic Community of West Africa States (ECOWAS) sub-region. Therefore, using SMEs from Ghana to test our hypotheses will help us to contribute to the IB literature by examining how and when firms could leverage the effects of R&D support in their internationalization drive (Adomako et al., 2021b; Adomako, Amankwah-Amoah, Tarba, & Khan, 2021c; Adomako, Frimpong, Amankwah-Amoah, Donbesuur, & Opoku, 2021a).

Given that exporting is a primary mode of internationalization utilized by SMEs (Wolff & Pett, 2000; Zhang et al., 2016), we selected 700 firms from the Ghana Export database. Our sampling criteria met the following: (a) firms engaged in cross-border activities such as exporting, joint ventures, franchising, licensing and greenfield investment, (b) firms within 5 years of internationalization drive, (c) firms owned independently, without any company/group affiliation, and (d) manufacturers of physical products. This article focused on manufacturing SMEs because the manufacturing sector in developing economies is considered the engine of growth in terms of employment and other positive spillovers (Tybout, 2000). This paper also focused on SMEs because African countries are heavily dependent on SMEs to promote economic growth (Adomako et al., 2021a). For instance, Mamman, Bawole, Agbebi, and Alhassan (2019) reported that the SME sector accounts for 50% of employment in most of the sub-Saharan countries.

Chief executive officers (CEOs) of SMEs were contacted in person with our research questionnaire. We obtained 266 (representing a 38%) positive responses from contacting 700 CEOs. As single-source data is often associated with common method variance (Podsakoff, MacKenzie, & Podsakoff, 2012), we contacted the finance managers of the 266 firms to capture the degree of internationalization 3 months after the first survey. We received 232 responses from the finance managers. After discounting missing values, the final sample comprised 227 firms. This represents a 32.42% response rate.

We determined the possibility of nonresponse bias affecting our data, comparing respondents with non-respondents in terms of firm size, age, CEO age, and industry distribution of the firm. Our multivariate *t*-tests show no significant differences in respondents and non-respondents, indicating that nonresponse bias is not a major concern in the data (Armstrong & Overton, 1977).

3.2 | Measures

Table 1 shows the measures, validity, and reliability assessment. The study used multi-item scales measured on a seven-point Likert scale, with anchors ranging from 1 = strongly disagree to 7 = strongly agree.

3.3 | R&D support

SME involvement in R&D funding was measured using government grants as a proxy investment (Kang & Park, 2012). We followed the same approach to assess R&D support as follows: 1 = the firm received government grants for its projects in a particular year and 0 = otherwise.

TABLE 1 Details of measures, results of validity tests

Measure details	Factor loadings (*t*-value)
Technology turbulence : ($\alpha = .85$; CR = .86; AVE = .71)	
The technology in our industry is changing rapidly	.91 (1.00)
Technological changes provide substantial opportunities in our industry	.89 (27.11)
A large number of new product ideas have been possible due to technological breakthroughs in our industry.	.88 (26.83)
It is very difficult to forecast where the technology in this area will be in the next few years.	.78 (16.99)
Technological capability : ($\alpha = .89$; CR = .90; AVE = .77)	
Acquiring important technology information	.76 (1.00)
Identifying new technology opportunities	.79 (17.28)
Responding to technology changes	.87 (22.15)
Mastering the state-of-art technologies	.78 (16.97)
Developing a series of innovations constantly	.83 (21.33)
Financial resource availability : ($\alpha = .94$; CR = .94; AVE = .68)	
We are satisfied with the financial capital available for the business operations	.70 (1.00)
Our company has easy access to financial capital to support its business operations	.74 (14.62)
Our business operations are better financed than our key competitors' operations	.87 (19.15)
If we need more financial assistance for our business operations, we could easily get it	.79 (16.16)
We are able to obtain financial resources at short notice to support business operations	.72 (14.34)
Degree of internationalization : ($\alpha = .86$; CR = .86; AVE = .73)	
This company is entering new foreign markets	.89 (1.00)
Our company expanding your international operations	.84 (22.41)
We are supporting start-up business activities dedicated to international operations	.79 (18.11)
This company is financing start-up business activities dedicated to international operations	.70 (13.66)

Note: The *t*-values have been placed in parentheses.
Abbreviations: AVE, average variance extracted; CR, composite reliability; α, Cronbach alpha value.

3.4 | Technological capability

We adapted the technological capability scale developed by Zhou and Wu (2010). We asked respondents to compare their firms to major competitors and evaluated their firms' capabilities using five items on a seven-point scale (1 = much worse; 7 = much better).

3.5 | Technological turbulence

We adopted the items from Lee and Tang (2018) to capture the degree of technology turbulence. Each of the four items was measured on a seven-point scale ranging from 1 = strongly disagree to 7 = to strongly agree.

3.6 | Degree of internationalization

A firm's degree of internationalization was captured by using four items from Zahra, Neubaum, and Huse (2000b). These items asked finance managers the extent of their firms' internationalization activities over the past 3 years. Therefore, the intensity of internationalization-venturing activities that a firm has undertaken was measured (Yiu et al., 2007).

3.7 | Control variables

The following control variables (firm size, firm age, international experience, industry, CEO age, and availability of financial resources) were used to account for their impact on the study model. We used the number of employees to measure the firm size.

Firm size was one of the control variables as larger firms tend to have more resources that affect their degree of internationalization (Zahra, Ireland, & Hitt, 2000a). For firm age, we adopted firm year of inception as a proxy. We measured firm age by using the firm's number of years in operation (George, 2005), and this is a control variable; thus, older firms tend to have more resources, which may influence their tendency to enter international markets (Karami & Tang, 2019). Years of international experience was controlled for because a firm's international experience may impact its international behavior. We captured years of international experience as the number of years a firm had operated in international markets. We used nine manufacturing industry qualifications as control variables (Karami & Tang, 2019): (a) beverage, tobacco products and food; (b) footwear, clothing, textile and leather; (c) paper products and wood; (d) printing; (e) rubber products, petroleum, chemical and polymer; (f) non-metallic mineral products; (g) metal products; (h) equipment and machinery; and (i) furniture and other manufacturing. We then categorized these groupings into high or low technology industries based on R&D expenditure scores and the ratio of knowledge workers in each industry (Karami & Tang, 2019). These classifications were carried out because high-technology firms are more likely to enter foreign markets (Oviatt & McDougall, 2005). Non-metallic mineral products, metal products, chemical, petroleum, polymer and rubber products were classified as "high-technology" industry and were coded as "1." The rest of the industries were considered as "low-technology industry" and were coded as "0." CEO's age was controlled for because it is an indicator of making confident decisions (Oesterle, Elosge, & Elosge, 2016). SMEs suffer from financial resource scarcity, which limits their foreign market commitment; therefore, availability of financial resources was controlled (Ripollés, Blesa, & Monferrer, 2012). We adapted the financial resource item from Cooper, Gimeno-Gascon, and Woo (1994) and Wiklund and Shepherd (2005). We asked our respondents to indicate the extent to which their firms have enough financial resources to enter a foreign market along a 7-point Likert-like scale (1 = very small extent; 7 = very large extent).

4 | ANALYSES

4.1 | Common-method variance, reliability, and validity assessment

Although we used data from difference sources for both dependent and independent variables, we undertook additional steps to ensure the data used in this study is free from common method variance (CMV). First, we adopted the strategy advanced by Lindell and Whitney (2001) and included a marker variable that was not conceptually related to any of the constructs in the model. Accordingly, we identified the "I like the color yellow." Results from the marker test show nonsignificant correlations between the marker variable and our dependent variable. Specifically, the results show that the correlation between the marker variable item and degree of internationalization is nonsignificant ($r = -.04$; $p > .10$). Also, the correlations of the marker variable item and other constructs were not significant, ranging from .00 to .05. This indicates that CMV does not materially influence the relationships between our constructs.

Second, we used Harman's one-factor test to establish whether CMV influences our findings. The results of a Harman's one-factor test in confirmatory factor analysis revealed a poor fit for the sample: χ^2 (df) = 584.66 (356); $p < .001$; RMSEA = .19; NFI = .34; CFI = .28. This suggests that a bias factor does not explain variances in the measures.

We assessed the reliability and validity of each construct using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The CFA was performed utilizing LISREL 8.1 statistical software. The results of the CFA yielded an adequate fit for the data: χ^2 (df) = 620.19 (375); $p < .00$; RMSEA = .05; NFI = .93; and CFI = .94. In addition, the factor loadings for each construct were significant at 1%, signifying convergent validity (Bagozzi & Yi, 1988).

We evaluated reliability using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). Results of the reliability assessment (Table 1) indicate that each construct had values greater than the suggested threshold value of .70 (Bagozzi & Yi, 1988). To establish discriminant validity, we used the procedure recommended by Fornell and Larcker (1981). Specifically, we inspected each construct's AVE and found that it was greater than the shared variances of each pair of constructs.

4.2 | Estimation and results

Table 2 shows the descriptive statistics and correlations of the variables in our research model. We mean-centered our variables to prevent spurious findings associated with multicollinearity before testing the hypotheses (Aiken & West, 1991). The suggested threshold value for the variance inflation factor (VIF) is 10 but the largest VIF in our regression is 3.35, which is below the accepted value (Neter, Kutner, Nachtsheim, & Wasserman, 1996). Thus, this regression result shows that our study was not affected by multicollinearity. In addition, we performed normality and outliers checks to ensure that these regression assumptions are not violated. There were no significant violations and thus our data was appropriate for the regression analysis.

Table 3 shows the output for our hierarchical regression analysis for the hypotheses. Technological capability is the dependent variable in models 1–4. In Model 1, all the control variables were included. Model 2 added the use of R&D support and it significantly influences technological capability ($\beta = .17$, $p < .01$). Thus, Hypothesis 1 received support. When technological turbulence is added in Model 3, the effect of R&D support on technological capability is still significant ($\beta = .19$, $p < .01$). Model 4 included the interaction term between R&D support and technological turbulence. The interaction term is positive and significant ($\beta = .46$, $p < .01$), indicating that technological turbulence positively moderates the effect of the use of R&D support and technological turbulence. To explain the nature of the significant interactions, the effect of R&D support on technological capability was plotted at high and low levels of technological turbulence (Aiken & West, 1991). Figure 1 demonstrates that the effect of R&D support on technological capability is stronger in a high turbulent environment than in a low turbulent environment. Thus, H2 also received support.

Hypothesis 3 is tested in models 5–8. These models allow us to test the mediating and moderating hypotheses. To test the mediating hypothesis, we followed precedence.

(An, Zhao, Cao, Zhang, & Liu, 2018; Zhao, Lynch, & Chen, 2010) and used Baron and Kenny's (1986) mediation procedure. According to the prescriptions of this approach, both mediator and independent variable should be significantly related. In Model 2, R&D support (independent variable) was positively and significantly related to technological capability (mediator) ($\beta = .17$, $p < .01$). Second, the dependent and mediating variables should be significantly related to each other. In Model 7, technological capability is positively and significantly related to a firm's degree of internationalization ($\beta = .32$, $p < .01$). Third, the effect of both dependent and independent variables should be nonsignificant or attenuated when the mediating

TABLE 2 Descriptive statistics and correlations

Variable	1	2	3	4	5	6	7	8	9	10
Firm size										
Firm age	−.05									
Firm international experience	.14*	.12								
Financial resource	.11	.09	.07							
Industry	.10	.06	.02	.04						
Founder/CEO age (years)	.00	.01	.09	.00	.02					
Technology turbulence	−.19**	−.11	−.18**	−.03	.12	−.11				
R&D support	−.25**	−.04	.10	−.12	.16*	.13	.22**			
Technological capability	.18**	.02	.33**	.20**	.11	.02	−.15*	.19**		
Degree of internationalization	.39**	.14*	.21**	.22**	.07	.12	.18**	.20**	.34**	
Mean	17.31	8.72	3.55	4.05	.83	48.11	4.53	.68	5.41	4.95
Standard deviation	8.70	6.75	.79	.70	.39	9.47	1.14	.47	.83	1.03

Note: *p < .05; **p < .01.

TABLE 3 Regression results

	Models 1–4: Technological capability				Models 5–8: Degree of internationalization			
Control variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Firm size (employees)	.14**	.13**	.14**	.14**	.19***	.20***	.21***	.21***
Firm age	.04	.04	.05	.06	.09*	.10*	.11*	.12*
Firm international experience	.17***	.18***	.19***	.20***	.14**	.14**	.16***	.15***
Financial resource	.11*	.11*	.12*	.12*	.14**	.15***	.14**	.13**
Industry	.04	.05	.06	.07*	.04	.05	.05	.06
CEO age	.05	.04	.05	.05	.09*	.09*	.10*	.11*
Independent variable								
R&D support		.17***	.19***	.20***	.15***	.16***		.04
Moderators								
Technological turbulence			.14**	.14**	.15***	.16***	.17***	.18***
Interaction								
R&D support × technological turbulence				.46***				.40***
Mediator								
Technological capability							.33***	.33***
Model fit statistics								
F	1.62	3.97***	5.43***	5.79***	2.72**	4.02***	6.76***	7.21***
R^2	.11	.18	.25	.27	.12	.16	.22	.26
ΔR^2	–	.07	.07	.02	-	.04	.06	.04
Largest VIF	2.31	3.35	2.16	1.22	1.19	2.10	1.69	1.58

Note: $N = 227$; * p < .10.; ** p < .05; *** p < .01; standardized coefficients are shown.

variable is included in the regression equation. In Model 8, when both R&D support and technological capability are included in the regression equation, technological capability has a positive influence on a firm's degree of internationalization ($\beta = .33$, p < .01). At the same time, the effect of R&D support on a firm's degree of internationalization becomes nonsignificant ($\beta = .04$, *ns*). These results show that technological capability mediates R&D support and a firm's degree of internationalization. Thus, Hypothesis 3 is supported.

4.3 | Endogeneity assessment

It can be argued that R&D support and technological capability could potentially be endogenous, as firms seeking R&D support are likely to have a stronger technological capability, and firms with greater technological capability are likely access R&D support. Thus, we addressed potential endogeneity problems (Zaefarian, Kadile, Henneberg, & Leischnig, 2017) using a two-stage least square (2SLS) estimation

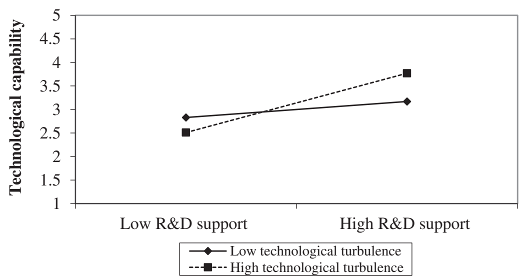

FIGURE 1 Interaction effect of R&D support with technological turbulence on technological capability

approach by following previous studies (see Adomako, Amankwah-Amoah, Tarba, & Khan, 2021c; Hamilton, Nickerson, & Owan, 2003). In Stage 1, we regressed technological capability against its predictor (*R&D* support) to obtain the predicted residual for the mediator (technological capability). In Stage 2, we included these residuals as the independent variable relative to degree of internationalization. The effect of technological capability residual on degree of internationalization is not significantly different from our initial results (Table 3). Thus, potential endogeneity between technological capability and degree of internationalization is not a major concern in our findings (Hamilton et al., 2003).

4.4 | Post hoc tests

We performed additional tests to substantiate the robustness of the findings reported in this study. First, we used the PROCESS macro approach advanced by Hayes (2013). We found support for H1 and H2. The results suggest a positive and significant effect of R&D support on both degree of internationalization ($b_3 = .16$; $t = 3.11$; $p < .01$) and technological capability ($b_3 = .18$; $t = 3.29$; $p < .01$). In addition, we found a positive and significant effect of technological capability on degree of internationalization ($b_2 = .32$; $t = 5.19$; $p < .01$). Moreover, the results suggest a significant total effect of R&D support on the degree of internationalization via technological capability, with an associated lower bound of .08 and upper bound of .29 using a bootstrap-estimated 95% confidence interval.

In testing the mediating hypothesis (H2), we used the PROCESS macro and inspected the conditional indirect effect of R&D support on internationalization via technological capability. Accordingly, we performed PROCESS macro analysis to test the conditional effect one standard deviation below the mean (-1 *SD*), at the mean (mid-point) and one standard deviation above the mean ($+1$ *SD*) of the moderator (technological turbulence), relative to the mediator variable (technological capability). The results using the mean values of the moderators show a positive relationship between technological capability and the degree of internationalization and this relationship is moderated by technological turbulence.

Second, we used an alternative measure of the degree of internationalization. Specifically, a firm's degree of internationalization was captured by using the country's scope. Accordingly, a country's scope is measured as the number of countries to which a firm's products were exported in 2018 (see Goerzen & Beamish, 2003; Tallman & Li, 1996; Zhang et al., 2016). The results show that all the hypotheses are supported, and the regression coefficients remained stable concerning magnitude, direction, and significance.

5 | DISCUSSION AND CONCLUSION

Drawing on the strategy tripod perspective (Peng et al., 2008, 2009) and data obtained from 227 firms engaged in cross-border activities, we sought to examine how R&D support influences SME internationalization through the mediating mechanism of technological capability. Our first finding (i.e., R&D support is positively related to technological capability) demonstrates the importance of the previously neglected role of government support building technological capability for SMEs in emerging markets. By using insights from studies on R&D support (e.g., Guo, Guo, & Jiang, 2016; Hsu, Horng, & Hsueh, 2009; Kang & Park, 2012), this study contends that government support is a valuable resource source for small firms to more efficiently and effectively build technological capability. Thus, this finding confirms the possibility of building firm-level capabilities through R&D support. Second finding (i.e., technological capability positively relates to SME internationalization) offers new insights that building technological capabilities is critical for a firm's degree of internationalization in an emerging market. We argued that technological capabilities are crucial in effecting the focal firm's internationalization (Zhang, Sarker, & Sarker, 2008; Zou, Liu, & Ghauri, 2010). In line with this assertion, our results support the positive effect of technological capability on the degree to which a firm internationalizes because great technological capability enhances the firm's footprint in the international market. Third finding (i.e., the relationship between R&D support and degree of internationalization is mediated by technological capability) reinforces the results of Hypotheses 1 and 2 by showing that the mechanism of R&D support influences a firm's degree of internationalization via the mediating process of technological capability. Also, the role of the external environment (technological turbulence) is hypothesized and tested in Hypothesis 3 as a moderator of the relationship between technological capability and degree of internationalization. Given that technological turbulence has crucial contextual influence on firm behavior in emerging markets (Bruton & Lau, 2008; Malik & Kotabe, 2009), it provides a better understanding as to how environmental factors can facilitate technology absorption and degree of internationalization in emerging economies. These findings provide important implications for the IB literature.

First, the findings enhance our understanding of the role played by R&D support in facilitating international business. The IB literature depicts that firms that involve themselves in R&D are likely to internationalize (Filatotchev & Piesse, 2009; Nam & An, 2017; Purkayastha, Manolova, & Edelman, 2018). However, the extent to which R&D support influences a firm's degree of internationalization has not been given the needed attention. In our study, we add to the previous studies that have studied the role of internal R&D expenditure on internationalization by arguing that R&D support is crucial for firms to increase their international expansion effort. Particularly, H1-H3 complement extant R&D research (e.g., Booltink & Saka-Helmhout, 2018) by proposing that R&D support could help firms identify greater international business opportunities through which to enhance their foreign expansion strategy. This is because government support acquired from R&D could promote firm innovation. This facilitates the identification of business opportunities in the international market (Cassiman & Golovko, 2011; Singh & Gaur, 2013). Thus, this study offers a more nuanced understanding of government support, which is critical for international business (Broocks & Van Biesebroeck, 2017; Korhonen et al., 1996; Nuruzzaman, Singh, & Gaur, 2019).

Second, the present study extends our knowledge on the boundary conditions of the impacts of R&D support on technological capability. Although the role of R&D support on technological capability has been examined (Adomako, Frimpong, Amankwah-Amoah, et al., 2021a; Kang, Baek, & Lee, 2017), the conditions under which the use of R&D support drives technological capability remain elusive. It can be concluded that this study is the first to examine technological turbulence, a moderating variable on this relationship. Particularly, the results in H2 indicate that environmental turbulence such as technology dynamism enhances the effect of technological capability on the degree of internationalization.

Third, our findings extend our current understanding of R&D support in emerging markets. Previous research shows that government involvement in R&D activities influences innovation and interfirm cooperation (Kang & Park, 2012). In contrast to the above, we show that firms in emerging markets can enhance their technology capabilities when they received support for their R&D activities. Our findings also show that firms with greater technological capabilities tend to boost their international expansion activities. These findings extend our knowledge beyond studies that suggest support in R&D relates to interfirm cooperation. This is an important extension given that economic liberalization in emerging economies has enhanced technological learning opportunities for emerging market firms (Malik & Kotabe, 2009) and this has helped these firms to leverage options for new products for the international market (Kumar & Siddharthan, 2013).

The present study has two practical implications. First, the results of this study indicate that R&D support can aid firms to build technology capabilities to expand into international markets. Most importantly, the use of R&D support enables firms to develop stronger technological capabilities which help them to eventually internationalize. This evidence is critical for SMEs in emerging markets that operate in institutionally constrained environments, which are commonly seen in emerging, transitioning and developing economies. Thus, SME managers from these economies could leverage their use of R&D support to build stronger technological capabilities to expand into new international markets. Second, the moderating hypothesis shows that technological capability has varying effects on the degree of internationalization depending on the degree of technological turbulence. For SME managers, building technological capabilities may not always drive a firm's propensity for internationalization when the firm's environment has low technological turbulence. Thus, SME managers should build technological capabilities when the technological environment is in a state of flux.

6 | LIMITATIONS AND FUTURE RESEARCH

Our study contains several limitations and thus offers opportunities for future research. First, we collected data from CEOs and finance managers to measure the dependent and independent variables respectively; the nature of our design (cross-sectional) did not allow us to make causal claims. A major avenue for future studies should be to exclude potential endogeneity concerns. For example, firms with stronger technological capabilities could make good use of R&D support and this raises the issue of reverse causality (Hamilton & Nickerson, 2003). Methodologically, we recommend that to solve this problem future studies should adopt a longitudinal design to collect data over time, and this permits the use of vector autoregression to analyze the Granger causality (Colombo & Garrone, 1996) among R&D support, technological capability and degree of internationalization. Second, we collected data from SMEs in Ghana and therefore we suggest that the empirical findings must be interpreted in the context of a developing country. Further studies should examine the use of R&D support, technological capabilities and degree of internationalization in highly developed countries, where firms typically have greater resources. This is likely to help future researchers to establish whether the findings discussed in our study could be validated. We also focused on SMEs as most firms from developing economies fall into this category. However, since larger firms have resources, they can develop greater technological capabilities by themselves, thereby rendering government support redundant. Third, we used reported and perceptual measures to capture the degree of internationalization. This has the tendency to introduce respondent bias into the sample. While the internationalization measure used in this study has been extensively utilized in international business studies (Adomako et al., 2017; Yiu et al., 2007; Zahra, Neubaum, & Huse, 2000b), we suggest that researchers should adopt the use of secondary sources of financial information.

In spite of the limitations, the findings suggest a positive correlation between R&D and technological capability. In addition, the results from our analysis revealed that the effect of R&D support on the degree of internationalization is mediated by technological capability. The findings also depict that the positive impact of R&D support on technological capability is moderated by technological turbulence. Collectively, the current study contributes to the IB literature in several ways. In particular, the study advances the IB literature by defining a clearer illustration of the mediating mechanism of the relationship between the use of R&D support and the degree of internationalization. We also show the conditions in which the use of R&D support impacts technological capability in an emerging market context.

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