

Collaboration breadth and innovation performance: The role of organisational motives

Athanasia D. Nalmpanti¹, Chee Yew Wong², Mario Kafouros³

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Introduction

Firms that openly innovate exchange knowledge with their external environment to achieve innovation success (Chesbrough, 2006; West and Bogers, 2014). In the literature of open innovation scholars are increasingly investigating how the purposive collaboration and co-creation for innovation outputs with complementary partners through alliances, cooperation, and joint ventures can further enhance innovation performance (Chesbrough, 2017). Accordingly, the literature suggests that *collaboration breadth*, as the extent at which the focal firm engages in formal innovation partnerships to source knowledge, skills, and resources, to successfully develop products and processes and effectively commercialize new ideas positively affects innovation performance (Cheng and Huizingh, 2014; Huang et al., 2019; Monteiro, Mol and Birkinshaw, 2017), but with diminishing effects (Hagedoorn, Lokshin and Zobel, 2018; Huang, Chen and Liang, 2018; Roper, Love and Bonner, 2017). Hence collaboration breadth might not be beneficial for innovation outputs under all circumstances.

We posit that it is highly unlikely that a high breadth of collaboration will be equally beneficial for all firms. Rather, the positive effects of collaboration breadth to innovation performance can be further enhanced under the presence of specific organizational innovation motives (economic, product/process, and social motives), as they can direct the organizational knowledge search to solutions that fit the innovation objectives of the firm and capitalize on ideas leading to innovation outputs (Leiponen and Helfat, 2010; Levinthal and March, 1993; Van de Ven and Polley, 1992). Research has recently called for identifying the contingency factors affecting the relationship between collaboration breadth and innovation performance (Chesbrough, Lettl and Rittle, 2018; Foss and Saebi, 2017). Accordingly, academic interest is growing, primarily exploring how absorptive capacity (Frenz and Ietto-Gillies, 2009; Kobarg, Stumpf-Wollersheim and Welp, 2018), governance mechanisms (Monteiro et al., 2017; Wadhwa, Bodas Freitas and Sarkar, 2017), environmental dynamism and technological turbulence (Cruz-González et al., 2015; Huang et al., 2018), and business environment (Huang et al., 2019; Terjesen and Patel, 2017) may moderate the relationship between high degrees of openness and performance. Still, research is far from exhaustive,

¹ Corresponding author: Frederick University, Nicosia, 1036, Cyprus

² Leeds University Business School, University of Leeds, Leeds, LS6 1AN, UK

³ Alliance Manchester Business School, University of Manchester, Manchester, M156PB, UK

especially in examining how innovation motives moderate this relationship. Given the significant role of innovation motives in the innovation process and knowledge strategy formulation (Mitchell et al., 2016; Palmer and Short, 2008; Van de Ven and Polley, 1992), this lack of research is surprising and needs to be addressed.

This paper aims to advance understanding on the contingent mechanisms that affect the effectiveness of openness by proposing that firms collaborate in their innovation activities to access knowledge, skills, and resources but differ in terms of innovation motives, which can affect innovation performance (Leiponen and Helfat, 2010). More specifically, the main thesis is that firms that access numerous collaborative knowledge sources can complement their internal knowledge base (Laursen and Salter, 2006), but their innovation motives can affect how they learn from their different innovation partners in ways they manage the challenges caused by over-search (Stephan, Andries and Daou, 2019; Tsinopoulos, Sousa and Yan, 2018). As such, we empirically address the research question of how specific innovation motives affect innovation performance and influence (moderate) the relationship between collaboration breadth and innovation performance. Correspondingly, a conceptual framework is developed to identify the mechanisms under which different types of innovation motives can determine whether they positively influence the relationship between collaboration breadth and innovation performance.

Theoretical background and hypotheses

Internal stocks of knowledge and resources are limited and organisations often engage in collaborations to source novel and unique knowledge, skills and resources to enable effective collaboration (Chesbrough, 2017). As such, collaborations not only provide opportunities for knowledge recombinations, interpretations, and successful commercialization (Kobarg et al., 2018), but also facilitate quicker and flexible market responses (Markovic and Bagherzadeh, 2018). However, firms with high collaboration breadth might face learning rigidities due to management attention issues, knowledge sourcing complexities and rising costs, compromising the benefits of broad collaboration networks (Laursen and Salter, 2006; Hagedoorn et al., 2018; Roper et al., 2017). These challenges may be addressed under the presence of economic, product/process and social innovation motives. Innovation motives can significantly affect the innovation process, as they largely define the formulation of the innovation strategy, they can drive the organisational context and form decision-making (Mitchell et al., 2016; Palmer and Short, 2008; Stephan et al., 2019).

In this context, organisational learning theory (OLT) as a theoretical background can facilitate understanding of the mechanisms by which organisations with collaboration breadth and high levels of economic, product/process and social motives can manage their diverse collaborations in ways that they overcome the challenges of openness (Laursen and Salter, 2006) and benefit their innovation outputs. OLT suggests that high levels of inter-organisational learning through collaborations may lead to improved innovation capabilities, explorative organisational behaviours and problem-solving opportunities (Jiménez-Jiménez and Sanz-Valle, 2011; March, 1991; Powell, Koput and Smith-Doerr, 1996). Yet, innovation targets can be fulfilled under the presence of innovation motives, as they direct firms proactively seek knowledge from collaboration partners that targeted towards their innovation needs (Levinthal and March, 1993).

Accordingly, firms make conscious choices over a number of alternatives that will help them improve their innovation returns (March, 1991). Therefore, firms are expected to focus their attention and resources to knowledge that is useful for achieving their respective innovation motives. For example, firms that are motivated by high levels of economic goals can improve their product innovation performance. Economic motives can affect how knowledge, solutions, and resources sourced by a broad collaboration network are selected, used, and integrated to achieve intended innovation economic outcomes. Under economic motives, the selection, use, and integration of knowledge is guided by economic benefits. Similarly, collaboration breadth provides firms with choice on different technologies and expertise to improve innovation outputs. When inspired by product and process innovation improvements, organisations form the scope and direction of their broad external knowledge search to technologies and solutions that advance their capacity, flexibility and quality of their internal products and processes (Tsinopoulos et al., 2018). Finally, firms gradually tend to open their boundaries and form partnerships to learn how to overcome knowledge rigidities on social innovations (Huang and Rice, 2012). It is anticipated that the interaction between the task of meeting social motives and the broad collaborative environment can lead to learning outcomes, which are useful for innovations (Argote and Miron-Spektor, 2011). Accordingly, we develop and empirically test three hypotheses:

***H1:** Economic motives of innovation positively moderate the effect of a firm's level of collaboration breadth on innovation performance.*

***H2:** Product and process motives of innovation positively moderate the effect of a firm's level of collaboration breadth on innovation performance.*

***H3:** Social motives of innovation positively moderate the effect of a firm's level of collaboration breadth on innovation performance.*

Data and sample

We employ an unbalanced panel dataset of 18,039 firm-year observations over the 2006 – 2016 period. The data have been collected by five consecutive waves of the UK Community Innovation Survey (CIS) (CIS6, CIS7, CIS8, CIS9, and CIS10), administered by the UK Office of National Statistics (ONS) and provided by the Department for Business, Innovation and Skills (2018) every two years. CIS has been widely used in the literature on open innovation (Grimpe and Kaiser, 2010; Laursen and Salter, 2006; Tsinopoulos et al., 2018) and constitutes an appropriate source of data for our analysis, as it provides multiple indicators of organisational innovation performance, and asks firms about different knowledge search strategies, and factors motivating innovation.

To measure the dependent variable, two separate proxies are used (Kobarg et al., 2018; Laursen and Salter, 2006), reflecting two types of innovation performance: radical and incremental. The development of the measurement of collaboration breadth, is analogous to the dominant way used in the literature (e.g., Grimpe and Kaiser, 2010; Laursen and Salter, 2014; Roper et al., 2017). Regarding innovation motives as moderating variables, we extend and adopt from previous research (Leiponen and Helfat, 2010; Tsinopoulos et al., 2018; Stephan et al., 2019), and we form three groups: 1. Economic; 2. Product and Process, and; 3. Social motives of innovation. We also employ the following control variables: squared term of

collaboration breadth, open depth, R&D intensity, lead user, firm size, employees level of education, market size, industry dummies, location dummies, and survey year dummies.

Due to the nature of the dependent variables (range 0-100) we apply censored Tobit models, following established literature on open innovation (Grimpe and Kaiser, 2010; Hagedoorn et al., 2018; Laursen and Salter, 2006), which are log-normalised (IHS) to improve their normality.

Results

The empirical results of the Tobit regression models examined are presented in *Table 1.1.* for radical innovation and *Table 1.2.* for incremental innovation. Our main hypotheses regression results are presented in models 4a and 4b, 6a and 6b, and 8a and 8b, where the interaction terms of collaboration breadth with economic, product/process, and social motives, are respectively examined. *H1* is confirmed as both interaction coefficients in the model for radical innovation (model 4a) and in the model for incremental innovation (model 4b) are positive and significant ($\beta_a = .305, p < 0.05$; $\beta_b = .423, p < 0.001$). Hence, the effective external knowledge use and integration is dependent on the presence of high levels of economic motives, which help firms select information that is relevant to such motives and can be translated to successful innovation. Such findings suggest that economic motives may be hierarchically regarded as the most important driver for using broad collaboration to innovate, compared with product/process and social motives. *H2* is only supported for the case of incremental innovation ($\beta_b = .547, p < 0.001$). This finding can be explained because possibly product and process motives emphasize mainly on technical aspects of innovation, which are more suitable for incremental innovation, rather than commercialization of radical new products and services. Last, with regards to *H3* (models 8a and 8b) for radical innovation, the effect is positive but non-significant ($\beta_a = .050, p = 0.571$), while for incremental innovation, the interaction coefficient is negative and non-significant ($\beta_b = -.034, p = 0.682$). These results provide no empirical support for *H3*, possibly because firms tend to source knowledge from their collaboration partners to achieve legitimacy (Tsinopoulos et al., 2018), rather than introduce innovations.

Discussion

This paper contributes to the literature by instigating the role and importance of organizational innovation motives in the open innovation process, to improve innovation outputs, and identify them as hitherto overlooked contingency factors on association between collaboration breadth and innovation performance. We examine each innovation motive in isolation, to advance knowledge on how and why different types of motives may cause different effects to innovativeness. The results reveal that the interaction effects of innovation motives on the collaboration breadth–innovation performance relationship can induce varied effects for different forms of innovation (i.e., radical and incremental) and for different sets of innovation motives (i.e., economic, product/process, and social). Therefore, this study extends the literature by suggesting that the innovation strategy of an organization defines the benefits of openness. Further, drawing from OLT, we unfold those learning mechanisms that can amplify the benefits of openness, and theoretically explain how firms that are motivated by economic, product/process and social innovation motives rationally choose to concentrate

their attention and resources to knowledge that is useful for their innovation objectives, thus overcoming the drawbacks of over-search (Laursen and Salter, 2006; Levinthal and March, 1993; Van de Ven and Polley, 1992). This paper, also, provides practical implications, as it broadens and deepens the managerial and policy making understanding of openness in shaping innovation performance, and informs on how to overcome the challenges of collaboration breadth by using specific innovation motives. This study has several limitations, which provide directions for future work. For example, future research can investigate the role of innovation motives in hierarchical, substituting, and/or complementary ways (e.g., using fuzzy set qualitative comparative analysis - fsqca), test in different geographical contexts, and examine different factors (e.g., relational capability).

Table 1.1 Regression results Radical Innovation

Variable	1a		2a		3a		4a		5a		6a		7a		8a	
	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>
R&D intensity	.145***	.024	.132***	.023	.132***	.022	.132***	.022	.136***	.022	.135***	.022	.188***	.029	.188***	.029
Size	-.200***	.022	-.243***	.022	-.255***	.022	-.257***	.022	-.250***	.022	-.250***	.022	-.248***	.022	-.249***	.022
Education	.017***	.002	.015***	.002	.016***	.002	.016***	.002	.016***	.002	.016***	.002	.015***	.002	.015***	.002
Lead user	.105	.082	.029	.081	-.034	.077	-.033	.077	.009	.077	.008	.077	.012	.078	.013	.077
Market size	.254***	.032	.188***	.032	.152***	.032	.150***	.032	.173***	.032	.173***	.032	.186***	.033	.186***	.033
Open depth	.980***	.052	.603***	.054	.165**	.054	.157**	.054	.150**	.054	.152**	.055	.220***	.054	.219***	.054
Collaboration breadth (CB)			3.26***	.251	.338	.261	-.073	.314	.375	.261	.457	.312	.641*	.261	.586*	.278
Collaboration breadth ²			-1.36***	.141	.063	.144	-.013	.147	.046	.144	.061	.147	-.088	.144	-.104	.149
Economic motives					1.21***	.134	.919***	.182	-	-	-	-	-	-	-	-
Economic motives × CB							.305*	.130	-	-	-	-	-	-	-	-
Product/process motives									1.20***	.132	1.26***	.183	-	-	-	-
Product/process motives × CB											-.061	.128	-	-	-	-
Social motives													.374***	.090	.318*	.134
Social motives × CB															.050	.088
No of Obs	11,581		11,344		7,886		7,886		7,935		7,935		7,822		7,822	
No of Obs uncensored	4,344		4,218		4,195		4,195		4,198		4,198		4,172		4,172	
Log-likelihood	-13071.814		-12411.147		-11864.501		-11861.766		-11886.625		-11886.509		-11809.37		-11809.209	
Wald χ^2	4335.61		4347.65		2507.82		2521.10		2526.59		2524.38		2452.59		2453.59	
Rho	.287		.317		.361		.361		.361		.361		.363		.364	
χ^2_{bar2}	97.23		103.34		.117.51		117.41		121.32		120.77		124.08		124.34	

*p < 0.05; **p < 0.01; ***p < 0.001; † p < 0.10.

Industry, location, and year dummies are included. Probabilities of Wald χ^2 test and χ^2_{bar2} are significant at the .001 level.

Table 1.2 Regression results Incremental Innovation

	1b		2b		3b		4b		5b		6b		7b		8b	
Variable	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>	<i>Coeff.</i>	<i>SE</i>
R&D intensity	-.035	.024	-.042†	.023	-.041†	.022	-.041†	.022	-.034	.022	-.032	.022	-.033	.023	-.033	.023
Size	-.075***	.020	-.116***	.020	-.125***	.020	-.127***	.020	-.118***	.020	-.118***	.020	-.124***	.020	-.124***	.021
Education	.008***	.001	.006***	.002	.007***	.001	.007***	.001	.007***	.001	.007***	.001	.006***	.001	.006***	.001
Lead user	.319***	.077	.220**	.077	.102	.072	.103	.072	.171*	.072	.176*	.072	.161*	.073	.160*	.073
Market size	.154***	.029	.097***	.029	.040	.029	.036	.030	.065*	.029	.067*	.029	.090**	.030	.090**	.030
Open depth	1.03***	.049	.678***	.051	.130**	.050	.118**	.051	.066	.051	.049	.051	.191***	.050	.191***	.050
Collaboration breadth (CB)			3.43***	.230	.403†	.234	-.189	.291	.201	.233	-.552†	.286	.786***	.235	.826***	.254
Collaboration breadth ²			-1.46***	.130	.008	.130	-.089	.133	.102	.129	-.028	.132	-.191	.130	-.181	.133
Economic motives					1.77***	.126	1.38***	.169	-	-	-	-	-	-	-	-
Economic motives × CB							.423***	.124	-	-	-	-	-	-	-	-
Product/process motives									2.07***	.125	1.58***	.164	-	-	-	-
Product/process motives × CB											.547***	.122	-	-	-	-
Social motives													.761***	.085	.799***	.126
Social motives × CB															-.034	.084
No of Obs	12,679		12,437		8,982		8,982		9,031		9,031		8,908		8,908	
No of Obs uncensored	5,657		5,483		5,433		5,433		5,448		5,448		5,409		5,409	
Log-likelihood	-16857.748		-16061.479		-15139.695		-15133.861		-15156.912		-15146.871		-15097.749		-15097.665	
Wald χ^2	5009.69		5110.80		2356.05		2379.49		2440.72		2477.98		2249.77		2249.07	
Rho	.251		.290		.343		.343		.334		.335		.345		.345	
χ^2_{bar2}	73.42		78.80		92.68		93.01		88.74		89.62		94.30		94.10	

*p < 0.05; **p < 0.01; ***p < 0.001; † p < 0.10.

Industry, location, and year dummies are included. Probabilities of Wald χ^2 test and χ^2_{bar2} are significant at the .001 level.

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