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Openness and Sensing Capacity: The Case of Micro and Small Furniture Industries in Tanzania

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ABSTRACT

Mainstream open innovation (openness) research has directly linked it to innovation performance, leaving intermediary processes such as innovation opportunity recognition (sensing capacity) not fully explained. This study examined the relationship between openness (inbound and coupled openness) and sensing capacity. The study surveyed a quota sample of 213 micro and small furniture industries (MSFIs) in Tanzania's cities of Arusha, Mbeya, and Dar es-salaam and applied a close-ended questionnaire to collect data from owners (managers) of the micro and small furniture industries. Subsequently, the study used partial least square structural modeling (PLS-SEM) to analyze the data and found that inbound openness positively affects sensing capacity directly and indirectly through coupled openness. Coupled openness partially mediates the effect of inbound openness on sensing capacity. Also, coupled openness positively affects sensing capacity. Openness and dynamic capabilities views are complementary; small business managers embracing inbound and coupled openness enhance their sensing capacity.

Introduction

Open innovation (openness) has become a priority innovation approach in small firms' research agenda and business practice (Krause & Schutte, 2015; Vanhaverbeke, 2017; Sprakel & Machado, 2020). Chesbrough and Bogers (2014) defined openness as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries. The main thesis is that firms opening to external parties such as customers, competitors, and research institutions gain external ideas and information to foster innovation performance (Chesbrough, 2003).

In opening to external parties, prior studies (Bigliardi et al., 2020; Mulyono & Syamsuri, 2023; Zajkowska, 2017) have shown that firms adopt three distinct openness strategies: inbound openness, coupled openness, and outbound openness. Inbound openness covers acquisition activities such as technology in-licensing and purchase of scientific services and search activities such as crowdsourcing or scanning from external parties that direct the flow of innovative ideas and information inside the firm (Mazzola, Bruccoleri, & Perrone, 2016; Teplov, 2018). Coupled openness involves structured inter-firm relationships such as alliances and joint ventures and simple cooperation between the firm and external partners such as customers and suppliers that enable them to share ideas and other resources for innovation (Hinterreger et al., 2018). Outbound openness reflects inside-out processes such as out-licensing, divesting, spin-off, supply of scientific services, and free revealing that transfer firms' ideas and knowledge resources to external parties (Mazzola et al., 2016; Teplov, 2018).

While there are three main openness strategies, micro and small businesses adopt mainly inbound and coupled openness due to their less formality and idea protection needs (Chabbouh & Boujelbene, 2022; Roper et al., 2017). Moreover, inbound and coupled openness directly relate to innovation in firms, whereas outbound openness relates to the commercialization of firms' innovations

(Ovuaokporie et al., 2021). Hence, this paper focuses on inbound openness involving informal external knowledge search activities that direct the flow of innovative ideas and information from external parties to the searching firms (Roper et al., 2017) and coupled openness involving simple relationships in which firms share innovation ideas with external parties (Hinteregger et al., 2018).

Following openness adoption in businesses, mainstream literature (Greco et al., 2016; Ham et al., 2017; Hartono & Abdur, 2022; Mazzola et al., 2016) directly linked it to innovation performance, getting results that range from curvilinear, negative, and positive. These ineffective results stem from businesses' poor selection of external ideas, high costs due to external ideas over-searching, and failure to manage external relationships (Laursen & Salter, 2006; Greco et al., 2016). As a result, a growing body of literature indicates that firms need dynamic capabilities, including sensing capacity, to manage openness (de Aro & Perez, 2021; Pihlajamaa, 2021). Schoemaker, Heaton, and Teece (2018) argue that firms need sensing capacity to detect opportunities and threats in environmental changes before today's volatile, uncertain, complex, and ambiguous (VUCA) surprise. Sensing capacity embodies cognitive and emotional capacities and systems for firms to analyze environmental changes and perceive their opportunities (Teece, 2007; Hodgkinson & Healey, 2011). Executing opportunities leads to innovation in new or improved products and processes (Lee & Yoo, 2019; El Hanchi & Kerzazi, 2020).

Despite the sensing capacity and innovation seemingly connected, extant openness research has not connected them adequately. Cirjevskis (2019), and Teece (2020), Hutton, Demir, and Eldridge (2021), and Pinarello, Trabucchi, Frattini, and Latilla (2022), for example, are anecdotal case-based, conflicting, and un-systematic. For example, Cirjevskis's (2019) case research argues that sensing capacity enhances coupled openness (alliance formation). Contrarily, Hutton et al. (2021) case research elucidates that openness enhances sensing capacity through seizing capacity; sensing capacity, in turn, fosters openness. Moreover, without specifying any order of occurrence, Teece (2020) elucidates that sensing capacity enhances openness, which, at the same time, enhances sensing capacity. Thus, the cause-effect relationship between openness and sensing capacity is still unclear.

As shown in Figure 1 of the conceptual framework, this paper assumes that openness precedes sensing capacity, hence providing quantitative evidence on the effect of openness on sensing capacity. According to the open innovation theory, inbound openness activities of searching for ideas and information from customers, suppliers, competitors, universities, and other external parties direct external ideas and information to firms (Chesbrough & Bogers, 2014; Enkel et al., 2009). As such, the external information and ideas increase with the number of external parties (inbound openness breadth) and their extent of interaction (inbound openness depth) (D'Ambrosio, Gabriele, Schiavone, & Villasalero, 2017; Laursen & Salter, 2006). Increasing the number of external parties and their interaction increases the firm's access to external innovation ideas and information.

The access to external ideas and information alerts entrepreneurs (firms) on opportunities (Ardichvili, Cardozo, & Ray, 2003; Shamudeen, Keat, & Hassan, 2017). The ideas and information come in pictures, conversations, and expressions on market and technology trends, and their analysis increases the chance that firms can sense innovation opportunities (Teece, 2007). Consequently, Seyfettinoglu (2015) revealed a positive effect of inbound openness on innovation idea generation (opportunity) among Turkish food and beverage firms. Therefore, this study hypothesized (H 1) that *inbound openness positively affects sensing capacity*.

Regarding coupled openness, it follows the complexity of innovation ideas. Filiou (2021) argues that firms will likely use coupled OI to coordinate distributed, complex, and overlapping tasks. Complex innovation ideas from inbound openness or creativity within firms compel them to collaborate with external parties for knowledge sharing (coupled openness). Spithoven, Vanhaverbeke, and Roijakkers (2013), Hottenrott, and Lopes-Bento (2016), and Seo, Chun, and Yoon (2017) argue that cooperation, due to knowledge and other resource sharing, exchange, and combining enable cooperating parties to access each other's complementary knowledge and know-how and enhance learning effectiveness in absorbing external knowledge (inbound openness generated ideas). Impliedly, an increase in external search activities increases the flow of complex external ideas in firms and respective external collaborations (coupled openness) to share, exchange, and combine knowledge and feedback on the complexity of the innovation ideas.

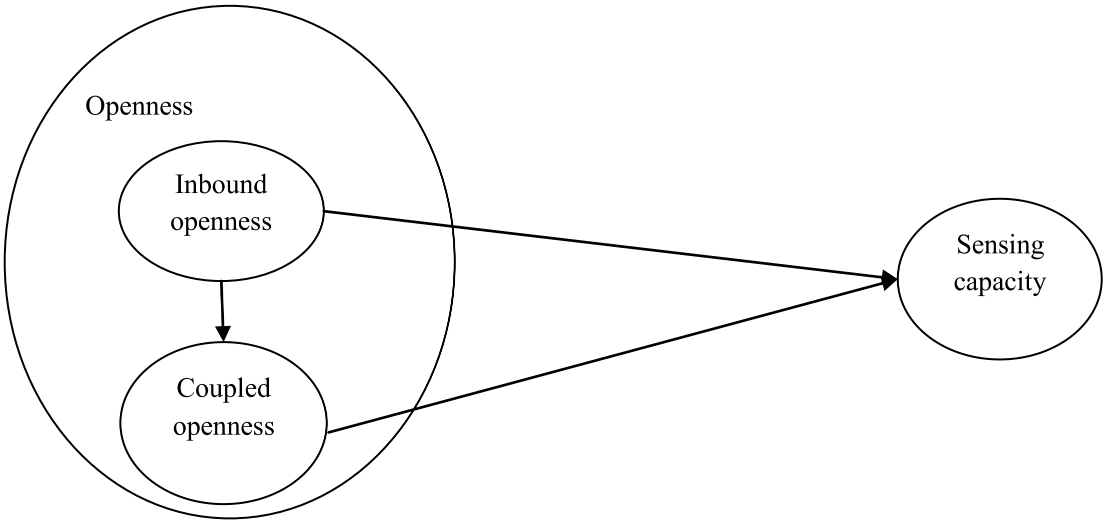

Figure 1. Conceptual framework
Source: Created by Authors

By sharing their knowledge and providing feedback, external cooperation partners enable firms to overcome their knowledge incapability and create synergy for enhancing analysis and interpretation of opportunities embedded in complex internal and external ideas. Collaboration with market-based partners, such as customers, enables firms to understand their needs well and discern market opportunities, whereas science-focused partners enable firms to understand technologies and discern technology opportunities (Gesing et al., 2015). Accordingly, Chen, Jiao, and Zhao (2016) found that cooperation in R&D improves technology capability regarding technology monitoring, absorption, and transference. Moreover, Rudolph (2017) indicates that cloud platforms allow different ecosystem actors, such as crowd platform developers, customers (users), and complementors, to share, exchange ideas, and integrate ideas that foster sensing (generation) of innovation opportunities. Also, Yun, Lee, Park, and Zhao (2019) found that experiencing, seeing, and communicating in coupled openness activities such as joint ventures motivate new markets, business models, and technology opportunities among serial entrepreneurs. Thus, based on this excerpt of literature, this study hypothesizes further that inbound openness positively affects coupled openness (H2), coupled openness positively affects sensing capacity (H3), and inbound openness positively affects sensing capacity through coupled openness (H4).

Given the sets of hypotheses in this study, a research objective that is geared to testing the hypotheses on the relationship between openness and sensing capacity is crucial. As stated earlier, extant studies are mainly anecdotal, qualitative case studies in high-tech industries without quantitative empirical tests on the relationship between openness and sensing capacity (or dynamic capabilities at large). Therefore, the purpose of this study is to examine the relationship between openness and sensing capacity based on micro and small furniture industries (MSFIs) in Tanzania.

METHODS

Following the implication of testing hypotheses in this study, it applied a survey research design. Surveys allow for gathering large quantitative data for hypothesis testing (Saunders, Lewis, & Thornhill, 2009). The survey involved sampling two hundred thirteen (213) MSFIs in Tanzania's Arusha, Dar-es-salaam, and Mbeya cities. This sample size decision is based on recommendations from the review of prior studies. Kline [(2011)], and Hair, Hult, Ringle, and Sarstedt (2017), in their review of prior studies, support a minimum sample size of 200 objects for studies involving complex structural equation modeling (SEM), an analysis technique that this study applied.

The choice of MSFIs based on the need to fill the gap in the dearth of openness research in low-tech industries (Hinteregger et al., 2018) and the largeness and competitiveness of the industry to guarantee the availability of adequate data. The MSFIs in Tanzania compose the third largest industry after food and wearing and apparel, and this industry is concentrated enough to foster competition (Dinh & Monga, 2013). Competition is relevant for innovation (Moen, Tvedten, & Wold, 2018; Basit, Kuhn, & Cantner, 2022), guaranteeing access to innovation data.

Subsequent to the sample size decision, the study applied a quota sampling procedure in selecting the MSFIs. Wards formed the quota as they cover walking distance streets that are close enough for their MSFIs to visit and copy each other's innovation ideas and be relatively homogeneous. The study involved selecting one ward with the highest number of licensed MSFIs (as an indication of the intensity of MSFIs) for every three wards in a given division. The selection of wards from different divisions ensured the representation of different parts of the cities in the sample, whereas the selection of wards with the highest number of MSFIs enhanced the likelihood of obtaining innovation data. The intensity of firms enhances competition, and, as stated earlier, Moen et al. (2018) and Basit et al. (2022) indicate that competition enhances innovation. Each of the selected wards with less than five, five up to ten, and more than ten licensed MSFIs contributed three, six, and nine MSFIs from different streets in a ratio of 1 top: 1 average: 1 low performer in owning modern furniture production machines. This procedure accounted for the proportionate intensity of MSFIs while ensuring variability of innovation performance data.

The wards executive officers, in their respective areas of jurisdiction, assisted the researchers of this study in identifying the MSFIs that are top, average, and low performers in owning modern furniture production machines and producing innovative furniture products. The ward executive officers know the MSFIs because they assist local government officers in monitoring the licensing status of micro and small businesses and levying them some local government taxes. The local government's city trade office in each area of study provided data on the distribution of licensed MSFIs by wards (as proxies for the intensity of MSFIs in each ward). Local authorities are responsible, in their respective area of jurisdiction, for licensing micro and small businesses in Tanzania. Based on this sampling procedure, the study purported to select a total of 252 MSFIs. However, due to non-response issues, the procedure yielded a final sample size of 213 MSFIs. A well-executed quota sampling is as good as stratified random sampling (Saunders et al., 2009).

The study gathered data from the owner (managers) of MSFIs using a close-ended questionnaire, parallel translated from English to Swahili (Tanzanian nation language), to clarify and enable their self-filling by respondents and avoid researcher bias (Saunders et al., 2009). Questionnaire items for inbound and coupled openness probed the managers to rate their use of listed external parties (from not used at all to always used on a five-point Likert scale) in sourcing and exchanging ideas and information for innovation, respectively. The list involved customers, social media, competitors, suppliers, universities (higher learning institutions), public institutions, research and technological centers, professional or sector associations, and consultants and commercial labs (Laursen & Salter, 2006; Hinteregger et al., 2018; Jugend et al., 2018).

The questionnaire items for sensing capacity probed the managers of MSFIs to rate their knowledge of best market practices and competitor activities, accessing new information systematically, and being updated on current market situations on a five-point Likert scale of agreement to disagreement (Kump, Engelmann, Kessler, & Schweiger, 2019). In addition, the study controlled for the firm's logarithm in the number of years of operation and yes to no export for engagement in foreign markets. These variables positively affected innovation in prior openness studies (Chou, Yang, & Chiu, 2016; D'Ambrosio et al., 2017; Rangus, Drnovsek, Di Minin, & Spithoven, 2017).

RESULTS AND DISCUSSION

To examine the relationship between openness and sensing capacity, as purported in this study, its quota sampling method generated useful data from

213 managers of MSFIs (response rate of 85 percent). Response rates such as 30-50, 60-69, and 70 and above percent are sufficient, good, and very good sample representatives (Saunders et al., 2009; Creswell, 2009). Analysis of the data involved two levels of analysis, namely descriptive analysis and inferential analysis. The descriptive analysis part used percentages to depict the size, forms of legal ownership, and experience of the MSFIs in the sample to understand their suitability. Moreover, the descriptive analysis involved the determination of normality of data based on mean, standard deviation, skewness, and kurtosis statistics; data reliability (based on Cronbach's Alpha and composite reliability indices); data validity (based on average variance extracted-AVE, and heterotrait-monotrait ratio-HTMT; and common method bias (based on full collinearity test). The inferential analysis for establishing the relationship between openness and sensing capacity used the Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis technique due to its suitability in explaining less developed theories that require both relationship prediction and explanation (Hair et al., 2017). As stated earlier, the relationship between openness and dynamic capabilities (sensing capacity) has yet to be fully theorized (West & Bogers, 2017; Teece, 2020).

The results of descriptive statistics in Table 1 describe the characteristics of micro and small furniture industries that the study sampled. Most of these MSFIs are micro-enterprises (62%), sole-owned (72%), and as young as below ten years (68%). These characteristics are a typical representation of micro and small businesses, which compose the majority of businesses, the majority of informal businesses, and the majority of young businesses due to high entry and exit rates.

Table 1. Profile of the sample of micro and small furniture industries

Characteristics	**Categories**	**Frequency**	**Percentage**
Number of employees	1-4 employees	132	62
	5-49 employees	81	38
Years of operation	5 or fewer years	91	43
	6-10 years	54	25
	More than 10 years	68	32
Form of ownership	Sole proprietorship	152	72
	Partnership	48	22
	Company	9	4
	Cooperation	4	2

Also, the results of descriptive statistics in tables 2, 3, and 4 below validate the normality, validity, reliability, and non-collinearity of the data from this study's sample, respectively. Specifically, table 2 indicates the adequacy of the sample data because none of the variables exceeded excess kurtosis and skewness of four (4) or missed any value. While PLS-SEM does not assume normality of data, data abnormality that is beyond excess kurtosis and skewness of 4 may bias PLS-SEM results (Hair et al., 2017). Also, table 3 shows that this study's variables met the reliability criterion for a minimum score of 0.7 composite reliability and 0.5 AVE and a maximum score of 0.85 HTMT (Hair et al., 2017). The data reliability followed the deletion of indicators Icla-10 for consultants and commercial labs in inbound openness and Ccla-7 for consultant and commercial labs in coupled openness as they loaded below 0.4, values low enough to warrant their deletion to enhance construct reliability (Tabachnick & Fidell, 2007). Lastly, table 4 shows no common variance problem because none of the variables exceeded the maximum VIF score of 5 in the full collinearity test (Kock, 2015).

Table 2. Descriptive statistics for normality of data

Variable	Mean	Std dev	Kurtosis	Skewness	No. of observations
CO	0.000	1.000	0.280	0.599	213.000
Export	0.000	1.000	14.216	3.742	213.000
Firm size	0.000	1.000	0.482	0.324	213.000
IO	0.000	1.000	-0.138	0.388	213.000
SSC	0.000	1.000	-0.251	-0.668	213.000

Notes: CO (coupled openness); IO (inbound openness); SSC (sensing capacity)

Table 3. Validity and reliability of latent variables

Construct	Cronbach α	Comp. Reliability	AVE	HTMT ratio	
			SSC	IOI	
IO	0.906	0.923	0.570		
SSC	0.861	0.906	0.706	0.518	
CO	0.874	0.905	0.614	0.742	0.518

Table 4. Inner VIF for full collinearity test on common method bias

Independent variable	Dependent variable: Firm type (micro Vs. small)
Coupled openness (CO)	1.895
Firm export intensity (Fexpo)	1.095
Firm size (Fsize)	1.138
Inbound openness (IO)	1.960
Sensing capacity (SSC)	1.018

To establish the relationship between openness and sensing capacity, this study analyzed the effect of inbound openness on sensing capacity, the effect of inbound openness on coupled openness, the effect of coupled openness on sensing capacity, and the effect of inbound openness on sensing capacity through coupled openness. The PLS-SEM analysis results for the analyses involved comparing models 1 and 2 in Table 5 below to aid in the selection of the best model. The results in model 1 include control variables in the analysis, and model 2 does not include control variables in the analysis. Model 2 (in Figure 2 of the PLS-SEM structural model output) depicts the best results that the study used for analysis. All the models, despite scoring model fit indices relatively higher than the CB-SEM based minimum model fit indices of 0.080 SRMR and 0.12 RMS_{Theta}, could be considered suitable for use in analysis because PLS-SEM fit indices are bound to be higher than CB-SEM criterion because the former maximises variance between the sample and its population parameters, whereas the later minimizes such the variance (Hair et al., 2017). However, this study selected to use model 2 results because it attained an adjusted R square (0.238) that is higher than the adjusted R square for model 1 (0.236), indicating that model 2 explains sensing capacity (dependent variable) more than model 1. After all, both the control variables in model 1 do not have significant effects on sensing capacity. Export intensity has a positive effect (β=0.055) that is insignificant ($p = 0.152 > 0.05$; bootstrap coefficients = -0.028 - 0.139 = 0) on sensing capacity. Firm experience has a positive effect (β= 0.047) on sensing capacity that is significant ($p = 0.221 > 0.05$; bootstrap coefficients = -0.058 - 0.1466 = 0).

Table 5. Effect of openness on sensing capacity

	Model 1	Model 2
Firm experience	0.047	
Export intensity	0.055	
IO→SSC	0.264**	0.456**
IO→CO	0.672**	0.672**
CO→SSC	0.264**	0.260**
IO→CO→SSC	0.177**	0.175**
Adjusted R square	0.236	0.238
SRMR	0.082	0.089
RMS_{Theta}	0.191	0.209

Notes: * significant based on p values only, ** significant based on both p values and bootstrap coefficients

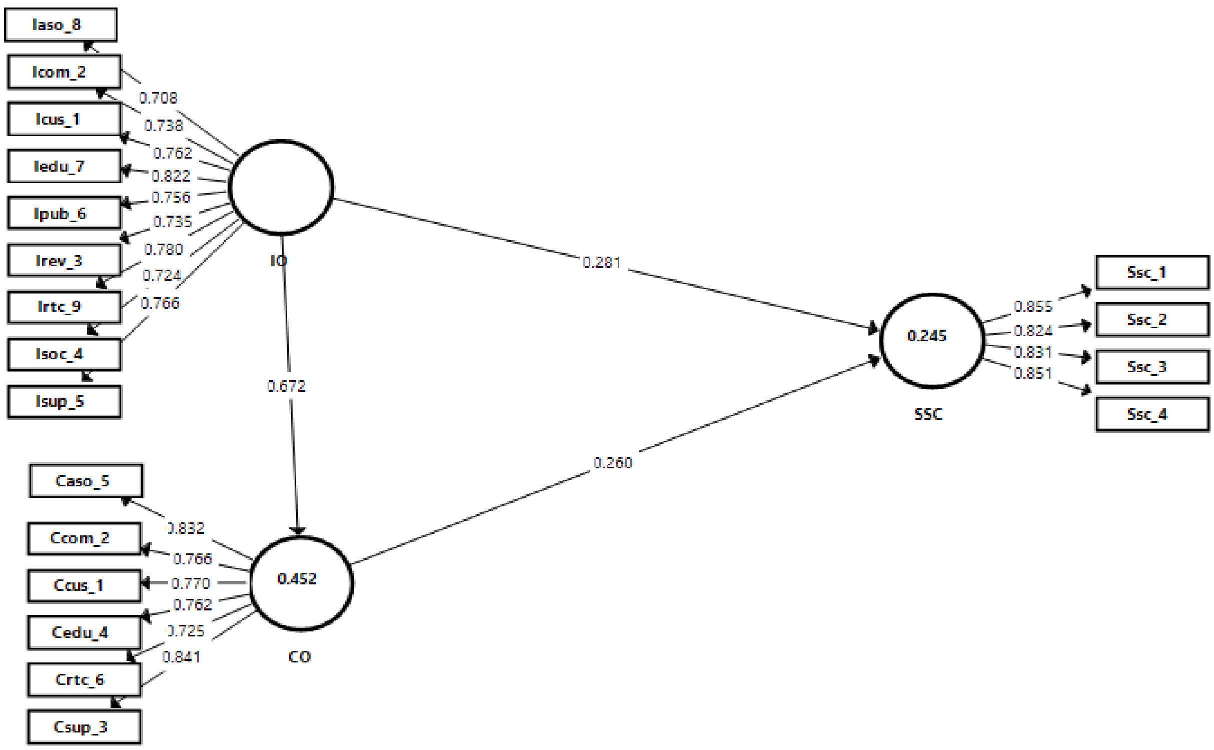

Figure 2. PLS-SEM structural model on relationship between openness and sensing capacity

Based on the results of model 2, table 5 shows that both inbound and coupled openness have positive significant effects on sensing capacity. Moreover, inbound openness has a significant positive effect on coupled openness and sensing capacity through coupled openness. Inbound openness has a positive effect on sensing capacity (β= 0.456) that is significant (p = 0.000< 0.05; bootstrap coefficients = 0.376 – 0.532 ≠ 0), confirming hypothesis 1. The effect of inbound openness on coupled openness is positive (β= 0.672) and significant (p = 0.000 < 0.005, bootstrap coefficients = 0.608 – 0.719 ≠ 0), confirming hypothesis 2. The effect of coupled openness on sensing capacity is positive (β= 0.264) and significant (p = 0.000 < 0.005; bootstrap coefficients = 0.156 – 0.406 ≠ 0), supporting hypothesis 3. The effect of inbound openness on sensing capacity through coupled openness is positive (β= 0.175) and significant (p = 0.00 < 0.05; bootstrap coefficients = 0.108 – 0.273 ≠ 0), supporting hypothesis 4.

Further analysis of the results indicated a positive effect of inbound openness on sensing capacity that is mediated by coupled openness. The significant positive direct effect of inbound openness on sensing capacity increased (β= 0.364) and remained significant ($p < 0.05$; bootstrap coefficients > 0). A significant effect of the dependent variable on the criterion variable when controlling and when not controlling for the supposed mediator entails partial mediation (Zhao, Lynch & Chen, 2010). Moreover, equality in signs of the indirect and direct effects entails complimentary mediation (Hair et al., 2017; Zhao et al., 2010). Thus, coupled openness is a partial complementary mediator between inbound openness and sensing capacity.

The results in this paper support our theorization that inbound openness strategies (inbound and coupled openness) positively affect sensing capacity directly. Also, the results support our prior theorization that inbound openness positively affects sensing capacity through coupled openness. The findings that inbound and coupled openness have positive direct effects on sensing capacity provide quantitative support to the findings in extant qualitative case studies (Cirjevskis, 2019; Teece, 2020; Hutton et al., 2021; Pinarello et al., 2022). These case studies suggest that openness enables firms to sense innovation opportunities. The logic behind these findings is that openness directs ideas and information inside the firm from customers, universities, competitors, and other private and government institutions. Also, the external parties, through collaboration, share ideas and information and provide feedback to the firm for its products and processes for further improvement. Subsequently, access to external ideas and information contributes to their analysis in firms based on experience, knowledge, and analytical tools to identify embedded opportunities (sensing capacity). Firms' access to external information enhances their opportunity alertness and subsequent opportunity recognition (Ardichvili et al., 2003; Shamudeen, Keat, & Hassan, 2017).

The indirect effect of inbound openness on sensing capacity through coupled openness reflects the fact that firms cannot, on their own, sometimes analyze and interpret the opportunities that inbound openness generates. Some external ideas that inbound openness generates are too complex to understand and interpret by firms. Hence, firms cooperate with competitors, customers, and other external parties who share their knowledge to enhance their understanding of complex external ideas and perceive their opportunities. The role of firms' collaboration with external partners in enhancing learning to absorb external knowledge has been highlighted in Pihlajamaa (2021). Nevertheless, Pihlajamaa (2021) simply describes the role of collaboration capability in facilitating inbound openness rather than the effect of collaboration on sensing capacity.

In contrast to this study, Ahn et al. (2016) equated coupled openness to knowledge management and showed that it predicts inbound openness and, consequently, innovation performance. Greco et al. (2016), Exposito, Fernandez-Serrano, and Linan (2019), and Kobarg, Stumpf-Wollersheim, and Welpe (2019) linked coupled openness to innovation performance directly and, in consequence, missed the linkages between coupled openness and sensing capacity. The differences in the results of this study and the past studies are methodological. The past studies mainly described the results of changing certain aspects of openness on sensing capacity and vice versa with little attention to their cause-effect relationship. This paper followed a systematic process modeling approach in line with actual processes in micro and small furniture firms. Furthermore, the current study quantified the effect of inbound and coupled openness on sensing capacity.

CONCLUSION

After examining the relationship between openness strategies and sensing capacity, this study concludes that openness enhances sensing capacity. Both inbound and coupled openness positively affect sensing capacity directly. In addition, inbound openness has a positive, significant indirect effect on sensing capacity through coupled openness.

The results of this study contribute to the literature in explaining the relationship between openness and dynamic capabilities. Teece (2020) indicated that prior studies were still to clarify which concept between openness and dynamic capabilities precedes another and appealed for their integration as separate but related concepts. This study has successfully tested the framework that inbound and coupled openness are predecessors of sensing capacity (dynamic capabilities). As a result, the findings provide quantitative evidence in support of existing qualitative case studies (Cirjevskis, 2019; Teece, 2020; Hutton et al., 2021; Pinarello et al., 2022) that suppose openness enhances sensing capacity.

Furthermore, this study has shown that coupled openness mediates between inbound openness and sensing capacity. Complex external ideas and information require firms to leverage their knowledge inadequacy through collaboration to enhance sensing capacity. As a result, the findings extend extant knowledge on the complementarity of openness strategies. Prior research (Cassiman & Valentini, 2016) revealed no complementarity between simultaneous implementation of both inbound and outbound openness. However, this study has shown that inbound and coupled openness are complementary if sequentially enacted, starting with inbound openness followed by coupled openness.

In addition, the results of this study support the application of theories of open innovation and dynamic capabilities in low-tech industries and, more importantly, in the least developed nations. Hinteregger et al. (2018) argued for inadequate open innovation studies in low-tech industries. Also, the review of literature in this study noted mainly anecdotal case research from European, Latin American, and Asian big economies that integrated openness and dynamic capabilities (Cirjevskis, 2019; Hutton et al., 2021; Pinarello et al., 2022; Teece, 2020). As a result, to the best of our knowledge, this study, except for Chabbouh and Boujelbene (2022), is one of the earlier attempts to bridge the contextual gap in knowledge about the integrated application of openness and dynamic capabilities in the low-tech industry context in Africa, particularly Tanzania. The study has shown that openness enhances sensing capacity (dynamic capability) even in low-tech industries (MSFIs) in least-developed countries of southern Africa like Tanzania.

In terms of practice, this study provides quantitative empirical evidence that small firm managers and their promoters embracing openness (inbound and coupled openness) improve sensing capacity. Inbound openness increases the flow of external ideas and information, alerting firms on potential opportunities and contributing to their recognition. Coupled openness enables firms to access external cooperation partners' complementary knowledge for assistance in analyzing opportunities for complex external ideas. Unlike most anecdotal prior case studies (Cirjevskis, 2019; Hutton et al., 2021; Pinarello et al., 2022; Teece, 2020) that linked openness to sensing capacity, this study is quantitative.

Despite successfully explaining the relationship between openness and sensing capacity, this study has limitations. First, the cross-section approach, despite its edge in collecting large amounts of data that enhance generalization, does not trace the relationship between variables as they evolve over the other. Future studies may test this study's findings using longitudinal research. Second, this study is based on Tanzania's single, low-tech furniture industry. While the single industry offers sample homogeneity, its results can not apply directly to other industries before validation. Third, the partial mediation of coupled openness between inbound openness and sensing capacity suggests scholars can search for other mediators of the relationship. Partial mediation implies the omission of mediators (Zhao et al., 2010). Fourth, this study did not incorporate the transaction cost theory to understand the costs of enacting openness. Future research needs to unearth knowledge on transaction costs and enable a comparison of the cost of enacting openness strategies and the benefits in terms of sensing capacity.

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