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DOI:
10.1016/j.techfore.2023.122632

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Zahoor, N & Adomako, S 2023, 'Be open to failure: Open innovation failure in dynamic environments', *Technological Forecasting and Social Change*, vol. 193, 122632. https://doi.org/10.1016/j.techfore.2023.122632

Technological Forecasting & Social Change 193 (2023) 122632

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

Be open to failure: Open innovation failure in dynamic environments

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ARTICLE INFO

Keywords:
Environmental dynamism
Organizational learning culture
Open innovation
Relational trust
SMEs
Emerging markets

ABSTRACT

Despite the considerable efforts made to investigate the factors that could potentially influence open innovation (OI), very little is understood about the impact of environmental factors such as dynamism. In addition, the question relating to the relationship between environmental factors and OI remains unresolved. Further, the conditions under which this relationship is more or less pronounced are also little understood. With our study, we examined these gaps through data collected from 209 emerging market small and medium enterprises (ESMEs) operating in the United Arab Emirates (UAE). Our analyses show that environmental dynamism negatively influences OI and that this nexus is mediated by organizational learning culture. In addition, we found that the mediation effect of organizational learning culture is moderated by relational trust, in that it is improved at high levels of relational trust. Finally, we found that the organizational learning-OI nexus is moderated by firm size and industry type. These findings extend our knowledge of the role played by micro-environmental factors in OI activities.

1. Introduction

Open innovation (OI) is considered to be one of the hottest topics in innovation management (Alassaf et al., 2020; Huizingh, 2011; Hutton et al., 2021). Although there are many definitions of OI (Chesbrough et al., 2006; Chesbrough, 2003; West and Gallagher, 2006), Chesbrough and Bogers (2014) offered the most recent as "*a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organisation's business model*" (p. 17). Thus, by opening up organizational boundaries, firms can rely on externalities to improve innovation processes (Zhang and Groen, 2021). Particularly, small and medium-sized enterprises (SMEs) overcome intensified competition in emerging markets by seeking OI (Nguyen et al., 2023; Sun et al., 2021). Emerging markets often exhibit continuous economic, institutional, and political disruptions with lower per capita and significant development challenges for SMEs (Markovic et al., 2021). An important factor that emerging market SMEs (ESMEs) ought to consider is external partners to seek OI.

Although the current literature presents a positive view of OI for ESMEs (Marzi et al., 2023; Tsai et al., 2022), its limitations and failure rates are still not adequately examined (Lhuillery and Pfister, 2009). Instructively, prior studies reveal that many external collaborations fail because they are unable to deal with environmental dynamism (Gulati and Singh, 1998; Sutcliffe and Zaheer, 1998). For example, Krishnan et al. (2016, p. 57) argued that "*environmental dynamism, the difficulty in predicting external changes outside the control of the alliance, is a key factor underlying coordination difficulties that are innocent and non-strategic*." Despite these contentions, to date, the empirical examination of the relationship between environmental dynamism and OI in the context of ESMEs remained underexplored. As emerging markets lack proprietary advantages and have weak institutional environments, this creates additional uncertainty for ESMEs, especially when relying on external partners for technology/knowledge inflow and outflow (Purdy et al., 2023). Thus, our study focuses on the ESME as compared to the advanced economy counterparts, they are often hindered in achieving any competitive advantage due to their weak resource base and lack of technical knowledge and skills (Jin et al., 2019; Mei et al., 2019).

Our study addresses the impact of environmental dynamism on OI by drawing insights from organizational learning theory (Argyris and Schon, 1978; Schon, 1983) and relational capital (Gulati, 1995; Nahapiet and Ghoshal, 1998). Collectively, we argue that environmental dynamism reduces the predictability of future resources, and thereby reduces OI activities (Madhok et al., 2015). Thus, we examined the

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https://doi.org/10.1016/j.techfore.2023.122632
Received 6 December 2022; Received in revised form 30 March 2023; Accepted 7 May 2023
Available online 20 May 2023

following research questions: (1) "*To what extent do environmental dynamism and organizational learning culture affect OI?*" and (2) "*How does relational capital moderate the relation between organizational learning culture and OI?*" To address these questions, we collected survey data from 209 ESMEs operating in the United Arab Emirates (UAE)—an emerging Middle Eastern market.

Our study makes several important theoretical contributions to the literature. First, it extends the existing OI literature (Jin et al., 2019; Xie and Wang, 2021) by examining the effect of environmental dynamism on OI failure in ESMEs. Despite the instability and dynamic nature of emerging markets (Elbanna and Fadol, 2016; Yu et al., 2013), the existing research has hitherto provided limited evidence on the implications of environmental dynamism for OI. Our study fills this gap by providing an understanding of the environmental dynamism-OI nexus in the ESME context.

Second, by examining organizational learning culture as a mediating mechanism between environmental dynamism and IO, this paper contributes to the organizational learning literature (Argyris and Schon, 1978; Schon, 1983). By testing a model that specifies how the organizational learning culture mediates the environmental dynamism-OI relationship, our study extends the current organizational learning and OI literature by advancing our understanding of the mechanisms through which environmental dynamism influences OI in ESMEs.

Third, it integrates the relational capital (Dyer and Singh, 1998; Uzzi, 1997) and learning literature (Hanvanich et al., 2006; Marsick and Watkins, 2003) to examine the conditions under which organizational learning culture plays a vital role for OI.

Fourth, by testing the moderating impact of relational trust on the organizational learning culture–OI nexus, it broadens the current knowledge on when organizational learning culture does effectively influence OI. This is an important extension of the IO literature, given the lack of studies elucidating the boundary conditions of this nexus.

Finally, in response to recent research calls (Obradović et al., 2021; Zahoor and Al-Tabbaa, 2020), we investigated the moderating impact of industry sector and firm size on the relationship between organizational learning culture and OI by highlighting that the moderated effect of relational trust on the organizational learning culture-OI nexus is stronger for firms operating in low-technology industries and for medium-sized firms. Overall, our findings provide a very fine-grained understanding of the factors that limit or enhance OI activities across different sectors and types of firms, given that firms have different resource bases.

2. Theoretical background and hypotheses

2.1. Organizational learning theory

In this study, we use the organizational learning theory (Argyris and Schon, 1978) to highlight how ESMEs can learn and adapt over time and improve their innovation performance and effectiveness by developing a culture of continuous learning. Given that it is a seminal work in the study of organizational learning (Argyris and Schon, 1978; Hurley and Hult, 1998), we contend that it can provide a useful framework for understanding the relationship between environmental dynamism, organizational learning culture, and open innovation. First, the organizational learning theory suggests that organizations can improve their performance and innovation capabilities by developing a culture of continuous learning and knowledge sharing (Jiménez-Jiménez and Sanz-Valle, 2011; Liao et al., 2008). This theory posits that an organization's learning culture mediates the relationship between environmental dynamism and open innovation. In the context of the UAE, an ESME that has a strong learning culture would be better equipped to deal with the challenges posed by the task environment. For example, an ESME that is committed to continuous learning and knowledge sharing would be more likely to collaborate with external partners to develop new ideas and solutions to the challenges in the task environment. Thus, the organizational learning theory provides a useful framework for understanding how environmental dynamism can impact open innovation in the UAE context, and how organizational learning culture can mediate this relationship. By developing a strong learning culture, organizations can overcome the barriers to open innovation posed by environmental dynamism and drive sustainable growth and innovation.

2.2. Open innovation

Open innovation refers to "*the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively*" (Chesbrough, 2006, p. 2). This definition has been further developed and clarified to "*a distributed innovation process based on purposefully managed knowledge flows across organizational boundaries*" (Chesbrough and Bogers, 2014, p. 17). As such, it involves the two prominent categories of inbound and outbound OI. While inbound OI refers to the inflow of knowledge and inputs from external partners aimed at facilitating innovation (Jasimuddin and Naqshbandi, 2019), outbound OI relates to the leveraging of internal resources and knowledge toward external partners by licensing and forming alliances suited to generate value (Bellantuono et al., 2013). By combining inbound and outbound OI activities, ESMEs can accrue numerous benefits, including cost and risk reduction, knowledge acquisition, and capability development (Gimenez-Fernandez et al., 2020; Hervas-Oliver et al., 2021; Singh et al., 2021). In addition, ESMEs involved in OI tend to be the first to introduce innovative products and services, instead of acting as first followers (Hochleitner et al., 2017).

In our study, we argued that environmental dynamism creates rapid changes in competitive marketplaces that are likely to be ill-suited for OI "*because no new knowledge is obtained and no new possibilities for collective action are created*" (Eisingerich et al., 2010, p. 243). Therefore, the prevalence of environmental dynamism in emerging markets can negatively relate to OI. In this regard, organizational learning theory posits that the presence of environmental dynamism requires ESMEs to develop an organizational learning culture (Liao and Hu, 2007; Ojha et al., 2018a)—which refers to the sourcing, acquisition, creation, and internalization of knowledge (Marsick and Watkins, 2003). Environmental dynamism indicates high ambiguity and unpredictability, which quickly make products and services obsolete (Sørensen and Stuart, 2000). To minimize the effects of this obsolescence threat, ESMEs need to develop an organizational learning culture suited to the frequent generation, acquisition, and sharing of knowledge with organizational members aimed at overcoming market challenges (Chen et al., 2019; Reymen et al., 2017). A valuable organizational culture can enable ESMEs to successfully handle the difficulties pertinent to the OI process, including dealing with external entities and the internal integration of organizational resources and employees (Alassaf et al., 2020). For employees to accept collaboration with external partners for innovation, ESMES must establish a correct organizational culture. Against this background, researchers have called for studies aimed at investigating how ESMEs turn environmental dynamism in their favor by developing an organizational learning culture that supports OI activities (Obradović et al., 2021; Saura et al., 2022). Hence, we argued that ESMEs' organizational learning culture mediates the negative impact of environmental dynamism on OI.

However, it may be that an organizational learning culture may be more or less suited to OI under different relational settings (Naqshbandi and Tabche, 2018). In particular, the relational capital perspective suggests that relational trust—i.e., "*good faith in the intent and reliability of partner behavior*" (Krishnan et al., 2006, p. 896)—enables partners to hold common beliefs and to jointly commit to strategic alliances for OI (Dyer and Singh, 1998; Uzzi, 1997). In line with this, we posited that, in the presence of relational trust, ESMEs are expected to rely on their organizational learning culture to apply and commercialize their knowledge resources with external partners to support OI. Furthermore, prior research has argued that OI activities vary based on industry sector

(Mina et al., 2014; Naseer et al., 2021; Obradović et al., 2021) and firm size (Del Vecchio et al., 2018; Radziwon and Bogers, 2019). This suggests that industry sector and firm size can be important additional contingencies for the moderating role of relational trust. These arguments are captured in our proposed conceptual model in Fig. 1.

2.3. Environmental dynamism and ESMEs' open innovation

Environmental dynamism refers to the rate and unpredictability of the changes taking place in the external environment (Heyden et al., 2013). Research has long established that dynamic environment features—such as technological turbulence, competitive intensity, and market turbulence—can dissipate a given market and resource advantage (Porter, 1991; Simerly and Li, 2000). Extending this view, we suggested that any increase in environmental dynamism in emerging markets deteriorates the OI activities of ESMEs. In the face of stable environments, ESMEs can focus on aligning their collaborative innovation activities with predictable requirements (Cruz-González et al., 2015; Huang et al., 2023).

Further, as the emerging market environmental change rate is low or predictable, ESMEs can receive and process more accurate information and knowledge to support OI (McKelvie et al., 2017). In addition, such predictable environmental conditions imply that ESMEs can easily communicate and coordinate alliance tasks to gain in-depth insights into operational concerns, acquire tacit knowledge, and achieve potential efficiency gains from OI activities (Schilke, 2014). However, as the environment becomes more dynamic, it requires quick and responsive decision-making based on large amounts of accurate information provided by alliance partners (Hao et al., 2020). This creates issues of information overload that can lead to bottlenecks and hinder joint OI activities (Ringov, 2017). Further, high environmental dynamism leads to variability and calls for mutual adjustment, which, in turn, makes coordination highly demanding (McKelvie et al., 2017; Zheng and Yang, 2015). Given the relatively low levels of standardization found in emerging markets, ESMEs face significant adaptation problems with alliance partners, particularly under conditions of high interdependence (Dyer et al., 2018). In these cases, "*any changes from one partner to affect the other in unplanned ways and mistakes by partners would lead to more immediate and severe adverse impact on each other*" (Kwok et al., 2019, p. 5). When in dynamic environments, alliance partners are therefore more likely to violate their alliance agreements and seek private benefits, thereby leading to the deterioration of the joint alliance activities (Zhang et al., 2010), which may give rise to significant costs for partners for the development of innovative products.

The rationale for arguing for a negative relationship between environmental dynamism and open innovation in the UAE context is threefold. First, the environmental unpredictability such as the dynamism facing the is often complex and requires significant expertise and resources to address. This complexity and unpredictability in this context can make it difficult for organizations to find suitable external partners for open innovation projects (Cheffi et al., 2023; Zahoor et al., 2023). Second, the UAE has a highly regulated business environment, which can make it challenging for organizations to engage in open innovation activities (Zarrouk et al., 2021). Regulatory hurdles and bureaucracy can limit the ability of organizations to collaborate with external partners and can create barriers to entry for new players in the market. Moreover, the UAE is a highly competitive market, with a focus on fast-paced growth and innovation (Nuseir and Aljumah, 2020; Pervan et al., 2015). This competitive environment can make it difficult for organizations to engage in open innovation, as they may be hesitant to share their ideas and innovations with potential competitors. Based on the foregoing discussion, we contended that environmental dynamism causes alliance partners to act opportunistically and reduce OI activities. Thus, we hypothesize that:

Hypothesis 1. Environmental dynamism is negatively related to open innovation.

2.4. The mediating role of an organizational learning culture

Environmental dynamism makes it difficult for ESMEs to seek and exchange knowledge with their alliance partners (Mei et al., 2019). In particular, in emerging markets—which are characterized by volatility and underdeveloped institutional safety nets (Hanousek et al., 2021; Mickiewicz and Olarewaju, 2020)—environmental dynamism presents ESMEs with OI problems such as lack of knowledge availability, difficulty in information verification and contract enforcement, and increased risk of partner opportunism (Dyer et al., 2018; Marino et al., 2008). To overcome such problems, ESMEs need to focus on internal organizational learning to reduce the negative impact of environmental dynamism on OI. Yet, developing a conducive learning culture may require additional resources and can be a costly process for those ESMEs that aim to benefit from OI activities.

First, ESMEs may view environmental dynamism in their emerging market as an opportunity to learn and acquire new knowledge (Corral de Zubielqui and Jones, 2020). Specifically, those ESMEs that perceive higher environmental uncertainty tend to promote an organizational learning culture for the internal sharing of knowledge (Kogut and Zander, 1992; Levitt and March, 1988). This requires them to compete with established rivals by experimenting, implementing multiple options, and testing new solutions (McKelvie et al., 2017). Given that it is difficult for an ESME to engage in such activities "*unless the culture is shaped to accept high levels of internal change*" (Teece, 2007, p. 1335), it needs to devise internal mechanisms and processes suited to create, diffuse, and internalize new ideas (Attia and Essam Eldin, 2018; Salvato and Vassolo, 2018). As Teece (2007) argued, environmental uncertainty requires adjustments made to organizational systems to "*minimize*

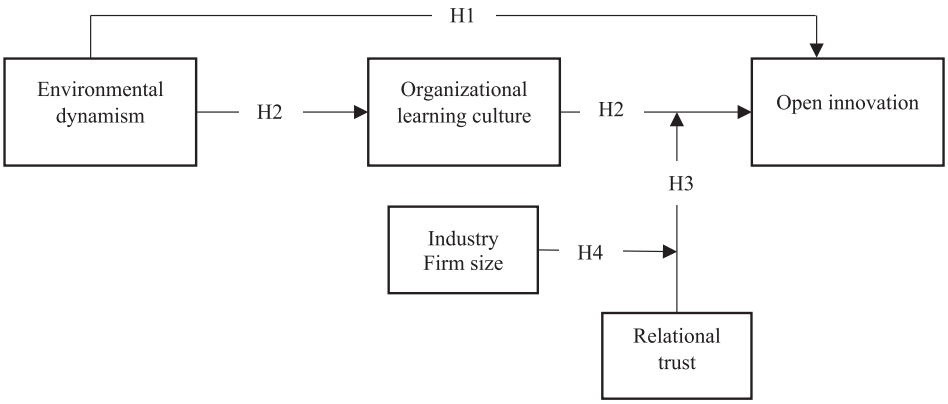

Fig. 1. The conceptual model of the study.

internal conflict and to maximize complementarities and productive exchange inside the enterprise" (p. 1336). Hence, environmental dynamism is a vital determinant of an ESME's organizational learning culture.

Second, an organizational learning culture can be an important factor in enhancing the knowledge and innovation absorbed from alliance partners (Khan et al., 2019). Those ESMEs that have developed a strong organizational learning culture can create, acquire, and transfer knowledge, as well as modify their behaviors to reflect their new knowledge and insights (Garvin, 1993; Huber, 1991). This helps them to better deal with their alliance partners to the end of transforming and exploiting the knowledge for OI (Ojha et al., 2018b). If ESMEs possess the necessary information and an understanding of opportunities–together with the ability to convert them into actions—they can more easily maintain better exchange relationships for OI (Škerlavaj et al., 2007). Thus, an organizational learning culture represents an important strategic asset, particularly in the context of emerging markets because, in this context, firms have a greater capability to catch up with their advanced economy counterparts (Bao et al., 2020; Heredia Pérez et al., 2018). The role played by organizational learning culture becomes vital for the design of the organizational structure, the improvement of managerial learning skills, and the enhancement of knowledge capability to the end speeding up the interaction process for joint innovation efforts (Liu, 2018). Cohen and Levinthal (1990, p. 138) noted that "*a firm without a prior technological knowledge base in a particular field may not be able to acquire one readily*". Thus, a strong learning culture on the part of ESMEs is vital to close the capability gap in an emerging market and promoting OI (Mani et al., 2020; Surdu and Narula, 2020).

On the whole, organizational learning culture acts as a mediator and facilitates the relationship between environmental dynamism and OI. In the knowledge exchange context, without an organizational learning culture geared to the free sharing, acquisition, and exchange of ideas, it would be difficult for ESMEs to exchange and internalize any complementary knowledge for OI in dynamic emerging markets (Attia and Essam Eldin, 2018; Lau et al., 2017). In addition, organizational learning culture helps firms to learn and internally share knowledge to cope with environmental dynamism, thus facilitating the exploitation of any external knowledge that can potentially improve OI. Previous research shows that external environmental issues serve as a trigger to generate an internal sense of failure (called a 'constructed crisis') and to create an internal learning environment (Kim (1998). Hence, in emerging markets, environmental dynamism plays a vital role in the development of an organizational learning culture suited to catch up with the competition and support OI. Thus, a strong organizational learning culture is likely to play an important role in enabling ESMEs to exploit the challenges presented by environmental dynamism regarding the development of OI. Based on this discussion, we proposed that:

Hypothesis 2. Organizational learning culture mediates the relationship between environmental dynamism and open innovation.

2.5. The moderating role of relational trust

Relational trust reflects "*the perceived honesty, fairness, and reliability by one partner in a buyer–seller relationship in the belief that the other will perform actions with positive results and/or prevent actions with negative outcomes*" (Bianchi and Abu Saleh, 2020, p. 576). According to the relational capital perspective, when firms nurture relational trust, they are better able to innovate through one-to-one interactions between alliance partners (Gulati, 1995; Zaheer et al., 1998). Relational trust is also critical to support the belief in mutual benefit throughout an organization (Nee et al., 2018; Parente et al., 2020). By maintaining high levels of relational trust, ESMEs are confident that their alliance partners will respond favorably, rather than opportunistically (Brattström and Faems, 2019). Relational trust implies that alliance partners care about each other, which makes their mutual relationships more accountable, durable, and stable (Dyer et al., 2018). Transferring any wrong information and defective knowledge would be harmful to the long-term success of collaborative innovation relationships (Liu et al., 2017); therefore, as relational trust grows, firms boost their learning culture efforts to promote the creditability of the transferred knowledge, which, in turn, promotes OI (Bouncken et al., 2020; Huikkola et al., 2013). For example, Liu et al. (2010, p. 241) suggested that the "*processes should be integrated to support an 'actionable learning system' to link the individual, group, and organizational level*". The presence of higher levels of relational capital may encourage ESMEs to disseminate information between and within organizations and becomes the basis for the socialization of knowledge for OI. In addition, relational trust bolsters organizations' skills and problem-solving capabilities, which encourages them to externally share knowledge without any worry that their alliance partners will take advantage of them and damage their interests (Han et al., 2020; Liu, 2018). By using relational trust as a moderator between organizational learning culture and open innovation, researchers can better understand how these factors interact and influence each other. This can lead to a more comprehensive understanding of the complex dynamics of open innovation and how it can be successfully implemented within organizations. Thus, relational trust forms the basis for an organizational learning culture suited to support OI. Thus, we proposed that:

Hypothesis 3. Relational trust positively moderates the relationship between organizational learning culture and open innovation, such that the relationship is amplified at high levels of relational trust.

2.6. The moderating role of the industry sector

The Organization for Economic Corporation and Development (OECD) classifies industry sectors based on R&D expenditure/intensity and technological advancement (Mendonça, 2009; OECD, 1993), with each sector experiencing different competitive forces. However, open innovation is equally important for both high- and low-technology firms (Bay and Çil, 2016; Yun and Mohan, 2012). For example, open innovation is critical for low-technology firms for "*product and process innovations*", "*new sources of supply*", "*exploitation of new markets*", and "*development of new ways to business*" (Szirmai et al., 2011, p. 5). Previous studies have argued that a learning capability may motivate low-technology firms to engage in open innovation (Bay and Çil, 2016; Belso-Martinez et al., 2013).

In our study, we argued that the moderation exerted by relational trust on the relationship between organizational learning culture and OI is stronger in low-technology ESMEs. First, the literature suggests that such firms face several challenges such as resource (e.g., human, financial, and technological) constraints (Hirsch-Kreinsen, 2008; Oduro, 2019), which causes them to rely on external information to develop innovation activities. Second, given their low R&D capabilities, OI is significantly feasible for them due to the possibility of external collaborations with other firms. We contend that low-technology ESMEs rely heavily on information and communication technologies and seem to use external knowledge more widely than their high-technology counterparts (Hameed et al., 2021; Paskaleva and Cooper, 2018). These firms appear to be more frequently engaged in OI activities with their customers and suppliers (Lütjen et al., 2019). The low R&D nature of low-technology ESMEs signifies that they need to engage in networking and alliance partnerships for OI activities (Hirsch-Kreinsen, 2008). These characteristics of low-technology ESMEs do not favor highly formalized contractual solutions (Mina et al., 2014; West and Bogers, 2017). Instead, the complexity "*requires more and deeper engagement of network partners and involves more dynamic, unpredictable and less standardized processes*" (Ovuakporie et al., 2021, p. 3). This suggests that relational trust is relevant for low-technology ESMEs to internally share information and coordinate OI activities and that this may be significantly more important for them than it is for their high-technology counterparts

(Lütjen et al., 2019; Ovuakporie et al., 2021). Therefore, we can expect that the moderating role of relational trust on the organizational learning culture – open innovation nexus will be stronger for low-technology ESMEs as compared to high-technology ESMEs. Thus, we hypothesize that:

Hypothesis 4a. Relational trust moderates the relationship between organizational learning culture and open innovation more positively in low-technology ESMEs than in high-technology ones.

2.7. The moderating role of firm size

We also investigated firm size as a moderator of the relationship between organizational learning culture and open innovation. In terms of firm size, OI has been widely studied in the context of ESMEs (Bhatti et al., 2021; Gentile-Lüdecke et al., 2020; Mei et al., 2019). A few studies have highlighted that OI activities differ between small and medium firms (Ahn et al., 2016; Lichtenthaler, 2008; van de Vrande et al., 2009), showing that they exhibit different behavioral patterns in alliance relationships and suggesting that they have different degrees of need for relational trust (Oakey, 2013). Small firms require limited amounts of resources from fewer alliances with specific partners (Greco et al., 2017). In contrast, medium firms engage in greater numbers of alliances for OI (Mei et al., 2019), and may be more capable, which makes it therefore more important for such firms to rely on relational trust to maintain close and frequent relationships with diverse alliance partners (Dyer et al., 2018). By maintaining high levels of relational trust, medium firms can develop a learning culture suited to absorb and share knowledge with their alliance partners, which is conducive to OI activities (Brem et al., 2017; Santoro et al., 2018). Hence, we hypothesized that:

Hypothesis 4b. Firm size moderates the interaction effects of relational trust on the indirect relationship between environmental dynamism and open innovation through organizational learning culture.

3. Method

3.1. Study setting

To test our hypotheses, we drew upon a sample of technological ESMEs operating in the UAE—a Middle Eastern country. Our choice of the UAE as our research setting was informed by several reasons. First, privately-owned SMEs are the major contributors to the country's economic activities, gross domestic product (GDP, 60 %), and employment (86 %) (Arabian Business, 2020). Second, the UAE is a fairly emerging market in the Middle East and has gone through economic transformation and policy interventions (Donbesuur et al., 2021; Nakos et al., 2019). The growing prominence of the non-oil sector, a booming tourism industry, and favorable trade policies have resulted in SMEs engaging in huge learning and innovation activities (Gupta and Mirchandani, 2018; Pervan et al., 2015). Thus, the UAE provided a unique context to test our framework. Data obtained from the UAE has a significant potential to contribute to the organizational learning and OI literature by enabling the examination of the role played by environmental dynamism, organizational learning culture, and relational trust in driving OI in ESMEs.

3.2. Data collection

The sampling frame used for our study was the Commercial Directory of the Dubai Chamber of Commerce and Industry (DCCI, 2018-19). To select our sample ESMEs, we used the following criteria: 1) independent firms that were not part of any business group; 2) firms that were privately owned and controlled by individuals (or teams of entrepreneurs) or had majority ownerships; 3) firms with <250 employees; and 4) firms with experience of alliances for innovation activities. These selection criteria yielded a random selection of 378 firms for participation in our study.

We surveyed the top managers (e.g., owners, CEOs, and senior managers) of the 378 selected firms. Before the survey, we conducted four in-depth pilot interviews with senior managers to ensure that our questionnaire was not affected by ambiguity. Following their feedback, we improved the questionnaire to enhance its clarity and designed the final version of the survey. We administered the survey in English because it is the first or second language for most organizations in the UAE (Al Ariss and Guo, 2016).

We collected data in two waves with a gap of approximately six months. Due to the challenges presented by collecting data in a developing country (Hoskisson et al., 2000), each wave lasted approximately two months. We made sure that all the independent, mediation, and control variables were captured in Wave 1, while the moderating and dependent variables were measured in Wave 2. We took a time-lag approach to reduce any potential common method bias associated with cross-sectional data (Podsakoff et al., 2003). To distribute the questionnaire, we employed a drop-off and collect technique (Aljifri and Khasharmeh, 2006; Elbanna and Fadol, 2016). The questionnaire was distributed to firms located in Dubai's Jebel Ali Free Zone, which is one of the leading free trade zones in the world (Jafza., 2020).

In Wave 1, we reached out to the chief executive officers (CEOs) of our sample 378 firms and received 231 responses (61.11 %). In Wave 2, we contacted the managers in charge of marketing and product development in each of these 231 firms for information on OI. Ultimately, we obtained 212 responses, as 19 firms did not employ marketing or product, development managers. After accounting for any missing values, we were left with 209 completed and matched responses, yielding an effective response rate of 55.29 %. Table 1 provides the demographic characteristics of the respondents.

3.3. Measures

We adopted the measurement items for our multi-item constructs from existing studies. All the measurement items were measured using 7-point rating scales. Table 2 provides details of the study's constructs and their corresponding measurement items.

3.3.1. Environmental dynamism

We measured environmental dynamism using the three-dimensional scale (market turbulence, competitive intensity, and technological turbulence) developed by (Jaworski and Kohli, 1993). We measured

Table 1
Demographic information.

Variables	Frequency (s)	Percentage (%)
Job position		
CEOs	123	56.7 %
Senior managers	94	43.3 %
Years served in firm		
0–5	57	26.3 %
6–10	100	46.1 %
11–15	16	7.4 %
Over 15 years	44	20.3 %
Firm size		
<50	80	36.86 %
50–100	76	35.02 %
101–250	61	28.11 %
Firm age		
0–5 years	42	19.4 %
6–10 years	62	28.6 %
11–15 years	41	18.9 %
Over 15 years	72	33.2 %

Table 2
Details of the measures, reliability, and validity.

Constructs and details of measures	Standardized factor loadings
Environmental dynamism	
Market turbulence (α = 0.91; CR = 0.91; AVE = 0.63)	
1. In our kind of business, customers' product preferences change quite a bit over time.	0.82
2. Our customers tend to look for new products all the time.	0.77
3. Sometimes our customers are very price-sensitive, but on other occasions, price is relatively unimportant.	0.80
4. We are witnessing demand for our products and service from customers who never bought them before.	0.79
5. New customers tend to have product-related needs that are different from those of our existing customers.	0.78
6. We cater to many of the same customers that we used to in the past.	0.79
Competitive intensity (α = 0.86; CR = 0.86; AVE = 0.56)	
1. Competition in our industry is cutthroat.	0.80
2. There are many "promotion wars" in our industry.	0.78
3. Anything that one competitor can offer, others can match readily.	0.74
4. Price competition is a hallmark in our industry.	0.70
5. One hears of a new competitive move almost every day.	0.71
Technological turbulence (α = 0.93; CR = 0.93; AVE = 0.73)	
1. The technology in our industry is changing rapidly	0.87
2. The Technological changes provide big opportunities in our industry.	0.86
3. It is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.	0.90
4. A large number of new product ideas have been made possible through technological breakthroughs in our industry.	0.79
5. Technological developments in our industry are rather minor.	0.87
Organizational learning culture (α = 0.92; CR = 0.92; AVE = 0.63)	
1. In our firm, people are rewarded for learning.	0.77
2. In our firm, people spend time building trust with each other.	0.79
3. In our firm, teams/groups revise their thinking as a result of group discussions or information collected.	0.86
4. Our firm makes its lessons learned available to all employees.	0.81
5. Our firm recognizes people for taking initiative.	0.88
6. Our firm works together with the outside community to meet mutual needs.	0.70
7. In our firm, leaders continually look for opportunities to learn.	0.71
Relational trust (α = 0.87; CR = 0.88; AVE = 0.64)	
1. Both parties would freely share concerns and problems and know that the partners would be interested in listening.	0.70
2. Both parties would let the other make decisions because we both think like one another.	0.87
3. Both parties can effectively act for the other because both share the same understanding of what matters.	0.83
4. Both parties are confident that their interests will be fully protected because both share a common identity.	
5. the bank would act in a fashion consistent with the customers' wishes without prior discussion with the bank	0.75
Open innovation	
Inbound open innovation (α = 0.89; CR = 0.89; AVE = 0.68)	
1. External partners, such as customers, competitors, consultants, or suppliers, are directly involved in all our innovation projects.	0.77
2. All our innovation projects are highly dependent upon the contribution of external partners, such as customers, competitors, consultants, or suppliers.	0.87
3. Our firm often buys R&D related products and services from external partners.	0.87
4. Our firm often buys intellectual property, such as patents, copyrights, or trademarks, belonging from external partners to be used in our innovation projects.	0.77
Outbound open innovation (α = 0.91; CR = 0.91; AVE = 0.71)	
1. Our firm often sells licenses, such as patents, copyrights, or trademarks, to other firms to better benefit from our innovation efforts.	0.88
2. Our firm often offers novel information, knowledge to other firms to better benefit from our innovation efforts.	0.90
3. Our firm strengthens every possible use of our own intellectual properties to better benefit our firm.	0.80
4. Our firm founds spin-offs to better benefit from our innovation efforts.	0.77

Note. α = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted.

market turbulence—which refers to the rate and predictability of change in the segments and preferences of customers (Hanvanich et al., 2006)—using six items from Jaworski and Kohli (1993). Competitive intensity—which relates to the degree of competition within a firm's industry (Chen et al., 2015)—was measured through five items drawn from Jaworski and Kohli (1993). Technological turbulence—which relates to the degree of change associated with technologies in an industry (Wilden and Gudergan, 2015)—was captured using five items developed by Jaworski and Kohli (1993). A composite of these three dimensions constituted the variable score for environmental dynamism.

3.3.2. Organizational learning culture

An organizational learning culture is conceptualized as one that promotes the sharing of knowledge and supports the implementation of new ideas (Naqshbandi and Tabche, 2018). It was measured using a seven-item scale from Marsick and Watkins (2003).

3.3.3. Relational trust

Relational trust refers to the goodwill, honesty, and good faith found among alliance partners, which mitigate risk by aligning core values (Schilke and Cook, 2015). It was measured using a four-item scale adopted from Poppo et al. (2016) and Saparito et al. (2004).

3.3.4. Firm size

Consistent with previous studies (e.g., Adomako et al., 2021), firm size was measured based on the number of employees. The natural log of the original value was used in the estimation.

3.3.5. Industry type

We relied on nine industrial classifications as follows: (1) food, beverage, and tobacco products; (2) textile, leather, clothing, and footwear; (3) wood and paper products; (4) printing; (5) petroleum, chemical, polymer, and rubber products; (6) non-metallic mineral products; (7) metal products; (8) transport machinery and equipment; and (9) furniture and other manufacturing. High-technology ESMEs, which refer to categories 5, 6, and 7 listed above, were coded as 1 (high technology). The firms related to the rest of the above classifications are categorized as low-technology and were coded as 0. These classifications were based on standardized R&D scores (Amankwah-Amoah et al., 2022).

3.3.6. Open innovation

We defined OI as the soliciting of ideas from and the sharing of internal intellectual property with domestic alliance partners (Chesbrough, 2006). Following previous studies (Cheng and Huizingh, 2014; Martinez-Conesa et al., 2017), we conceptualized OI along two

dimensions (i.e., inbound and outbound OI). Inbound OI relates to the sourcing and acquisition of expertise from domestic alliance partners (Huizingh, 2011), while outbound OI refers to the transfer of knowledge to domestic alliance partners (Lichtenthaler, 2015). Both inbound and outbound OI were measured using a four-item scale from Cheng Colin and Shiu Eric (2015). A composite of the two dimensions gave the variable score for OI.

3.3.7. Control variables

We controlled for managerial experience, firm age, and R&D intensity. We did so based on the existing organizational learning and open innovation literature (Naqshbandi and Tabche, 2018; Yu et al., 2013), which suggests that these variables may influence open innovation (Garcia Martinez et al., 2017; Thanasopon et al., 2016). Managerial experience was measured using the number of years each manager had been working with the firm (Boling et al., 2016). Firm age was measured as the number of years since each firm's inception. Due to high skewness values, we took the logarithm of our firm age measures. R&D intensity was measured using the ratio of R&D employees to total ones (Schmid et al., 2014).

3.4. Potential bias assessment

To probe for any potential non-response bias, we investigated two potential sources of non-response bias in our sample. First, we checked whether the CEOs who provided answers to the survey differed from those who did not respond to the survey. Assuming that late respondents are similar to non-respondents (Kanuk and Berenson, 1975), we performed a one-way ANOVA to compare key TMT characteristics. The results of the one-way ANOVA yielded no significant differences between early and late respondents. Second, we manually collected data on firm size, firm age, and CEO age in our database. We then compared the means of firm size ($t = 0.87$, ns), firm age ($t = 0.77$, ns), and CEO age ($t = 0.83$, ns) between responding and non-responding firms. These results demonstrate no statistically significant differences between the two groups, providing no evidence of nonresponse bias (Armstrong and Overton, 1977). We divided our respondents into early and late groups and compared them in terms of their demographics and the main variables of our study. The *t*-test results were found not to suggest any significant difference between the two groups. Hence, we concluded that non-response bias did not influence our dataset (Armstrong and Overton, 1977).

We investigated concerns for the presence of common method bias (CMB) arising from the cross-sectional nature of our study. To do so, we took an approach that involved ex-ante procedural and statistical techniques. For the ex-ante procedural techniques, we followed the recommendations of Podsakoff et al. (2003) about our questionnaire design. These included: 1) collecting data on the dependent and independent variables at two different points using multiple respondents; 2) defining any ambiguous terms; 3) keeping the questions simple and concise; 4) avoiding any double-barreled questions; and 5) protecting the anonymity of our respondents. In terms of the ex-ante statistical techniques, we estimated three competing confirmatory factor analysis (CFA) models: a method-only one (M1) in which all the items were loaded on a single latent construct ($\chi 2/df = 6.30$, CFI = 0.43, TLI = 0.37, RMSEA = 0.16, SRMR = 0.19); a trait-only one (M2) where each item was loaded on its respective latent construct ($\chi 2/df = 1.12$, CFI = 0.99, TLI = 0.98, RMSEA = 0.02, SRMR = 0.04); and a method-and-trait one (M3) in which a single factor was linked with the items in Model 2 ($\chi 2/df = 1.09$, CFI = 0.99, TLI = 0.99, RMSEA = 0.02, SRMR = 0.04). Subsequently, we compared these three models to determine which ones fit the data well. The results indicate that Models 2 and 3 were found to be superior to Model 1, with Model 3 not being substantially better than model 2. Thus, we concluded that CMB was unlikely to be affecting our results.

4. Analysis and results

4.1. Construct reliability and validity

We performed a CFA to assess the reliability and validity of all constructs. We tested a seven-factor CFA model that included market turbulence, competitive intensity, technological turbulence, organizational learning culture, inbound OI, outbound OI, and relational capital. The results were found to suggest that our measurement model fit the data well ($\chi 2/df = 1.12$, CFI = 0.99, TLI = 0.98, RMSEA = 0.02, SRMR = 0.04). Next, the reliability of our constructs was measured through Cronbach's alpha and composite reliability. As shown in Table 2, the Cronbach's alpha and composite reliability values for all the constructs were found to exceed the minimum threshold value of 0.70, suggesting high construct reliability (Hair et al., 2014). Further, we assessed convergent validity by inspecting the standardized factor loadings. Table 2 shows that the standardized factor loading of each construct was found to be significant for all items, with a minimum and maximum factor loading of 0.70 and 0.91, respectively. This confirmed the convergent validity of all our constructs. Moreover, following the recommendations made by Fornell and Larcker (1981), we assessed the discriminant validity of our constructs by establishing whether the squared average variance extracted (AVE) for each exceeded the correlation of each pair. Table 3 shows that the lowest squared AVE was found to exceed the highest correlation of 0.09. Thus, we concluded that the constructs used in our study had achieved discriminant validity. The correlation estimates and descriptive statistics of all the constructs are presented in Table 3.

4.2. Hypotheses testing

To test our nested structural models in path analysis, we performed structural equation modeling (SEM) using the AMOS 26.0 software. As we had performed a product-term analysis to test the moderating variable, we created a multiplicative term (organizational learning culture x open innovation) and used it to estimate the structural paths. However, the introduction of a multiplicative term could have given rise to multicollinearity problems. Thus, we orthogonalized the two variables involved in the interaction term (Little et al., 2006). In addition, we tested for multicollinearity using the variance inflation factor (VIF). The highest VIF value we found was 1.31, well below the threshold of 10 (Aiken et al., 1991). This suggested that multicollinearity did not influence our findings.

Subsequently, we estimated eight nested models, where Models 1 to 2 and Models 5 to 8 had OI as their outcome variable. In Model 1, we estimated the control variables and, in Model 2, the direct effect of environmental dynamism on OI. In Model 5, we estimated the effect of organizational learning culture on OI. The direct effects of environmental dynamism and organizational learning culture were added in Model 6. In Model 7, the interaction effect variable (organizational learning culture x relational trust) was added. Model 8 included the interaction effect variables (organizational learning culture x relational trust x industry; (organizational learning culture x relational trust x firm size). Models 3 and 4 had organizational learning culture as their outcome variable. Model 3 contained only control variables, while the independent variable (i.e., environmental dynamism) was added in model 4. The standardized coefficients and the significance levels for the seven models are presented in Table 4.

In Hypothesis 1, we argued that environmental dynamism will be negatively related to OI. Table 4 shows that the relationship between environmental dynamism and OI was found to be significant in Model 2 ($\beta = -0.20, p < 0.01$), thereby supporting H1, which, however, was only a baseline path to be estimated in our study.

In Hypothesis 2, we posited that organizational learning will mediate the negative effect of environmental dynamism on OI. Model 4 shows that environmental dynamism is positively and significantly related to

Table 3
Inter-construct correlation and descriptive statistics.

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. Managerial experience	9.48	6.24	1											
2. Firm size[a]	1.85	0.37	0.04	1										
3. Firm age[a]	0.98	0.33	0.07	0.08	1									
4. R&D intensity	0.23	0.39	−0.02	−0.42***	−0.01	1								
5. Industry[b]	0.49	0.50	−0.00	0.08	−0.08	−0.06	1							
6. Market turbulence	4.61	1.81	−0.04	−0.07	−0.08	−0.04	0.06	**0.80**						
7. Competitive intensity	4.43	1.70	−0.01	−0.04	−0.04	0.05	0.14**	0.48***	**0.75**					
8. Technological turbulence	4.40	1.70	−0.06	−0.06	0.07	0.14	−0.07	0.45***	0.36***	**0.86**				
9. Organizational learning culture	5.26	1.27	0.11	0.15*	0.03	−0.15*	−0.03	0.34***	0.10	0.21**	**0.80**			
10. Relational trust	4.99	1.34	0.03	0.12	−0.01	0.03	−0.05	−0.06	−0.15*	0.02	0.01	**0.80**		
11. Inbound open innovation	4.68	1.77	0.14*	0.17**	−0.01	−0.11	0.11	−0.04	−0.14*	−0.07	0.26***	0.11	**0.82**	
12. Outbound open innovation	4.48	1.91	0.09	0.15*	0.07	−0.09	0.05	−0.07	−0.25**	−0.19*	0.22***	0.10	0.19**	**0.84**

Note. S.D. = standard deviation.
[a] Natural logarithm transformation of the original values.
[b] dummy variable; bold values on the diagonal are square-root of AVEs; significance levels: * p < 0.05, ** p < 0.01 two-tailed, and *** $p < 0.001$.

Table 4
Results of the structural model estimation.

Variables	Model 1 open innovation	Model 2 open innovation	Model 3 organizational learning culture	Model 4 organizational learning culture	Model 5 open innovation	Model 6 open innovation	Model 7 open innovation	Model 8 open innovation
Control paths								
Managerial experience	0.15* (2.20)	0.13* (2.05)	0.09 (1.35)	0.11 (1.53)	0.12^{+} (1.77)	0.09 (1.49)	0.15 (1.39)	0.13 (1.10)
Firm age[a]	0.01 (0.16)	0.03 (0.38)	0.02 (0.23)	0.03 (0.39)	0.01 (0.21)	0.02 (0.31)	0.05 (0.46)	0.08 (0.72)
R&D intensity	−0.07 (−0.98)	−0.04 (−0.58)	−0.13^{+} (−1.74)	−0.13^{+} (−1.71)	−0.03 (−0.37)	0.00 (0.04)	−0.03 (−0.25)	−0.06 (−0.62)
Main effects								
Environmental dynamism		−0.20** (−3.01)		0.31*** (4.69)		−0.52*** (−4.02)	−0.53*** (−4.16)	−0.49*** (−4.16)
Organizational learning culture (OLC)					0.28*** (3.89)	0.65*** (4.68)	0.63*** (4.66)	0.59*** (4.58)
Relational trust (RT)							0.13 (1.21)	0.05 (0.41)
Industry (IND)								0.23* (2.19)
Firm size (FS)								0.18 (1.46)
Moderating effect								
OLC × RT							0.37** (3.22)	0.52*** (3.98)
OLC × RT × IND								−0.20* (−2.58)
OLC × RT × FS								0.23** (2.78)
Goodness-of-fit								
χ2/df	1.23	1.07	1.37	1.35	1.37	1.25	1.26	1.23
CFI	0.97	0.99	0.98	0.99	0.98	0.99	0.99	0.99
TLI	0.96	0.99	0.97	0.98	0.97	0.98	0.97	0.98
RMSEA	0.05	0.02	0.04	0.04	0.04	0.03	0.03	0.03
SRMR	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.02

Note. Standardized estimates are reported; T-values in parentheses.
† = dummy variable; significance levels: $^{+}p < 0.10$, * p < 0.05, ** p < 0.01 two-tailed, and *** p < 0.001.
[a] Natural logarithm transformation of the original values.

organizational learning culture (β = 0.31, $p < 0.001$). Model 5 demonstrates that organizational learning culture is positively and significantly related to OI (β = 0.28, $p < 0.001$). More importantly, Model 6 shows that the relationship between organizational learning culture and OI remains significant (β = 0.65, $p < 0.001$), but the magnitude of environmental dynamism ➔ open innovation is reduced (β = −0.52). This suggests the mediation effect of an organizational learning culture. It is important to highlight that our Hypothesis 2 involved an inconsistent mediation in which the mediating variable positive effect and the direct negative effect had opposite signs (MacKinnon et al., 2002). In this case, Baron and Kenny's (1986) approach and terminology of complete mediation or partial mediation were not appropriate to explain our inconsistent mediation model (Rungtusanatham et al., 2014). Therefore, we used a Bootstrapping method and the Sobel test to accommodate it.

First, we used model 1 of PROCESS macro, as designed by Hayes (2018). As shown in Table 5, the results of a 5000 bootstrap sample and bias-corrected 95 % confidence intervals suggest the indirect effect of environmental dynamism on OI via organizational learning culture (β = 0.11; CI = [0.04, 0.20]). In addition, the Sobel test revealed that organizational learning culture is a robust mediating variable (Sobel z = 3.76, $p < 0.001$). Overall, the results were found to suggest that organizational learning culture mediates the relationship between environmental dynamism and OI. Therefore, H2 was found to be supported.

Hypothesis 3 proposed that the effect of organizational learning culture on OI will be strengthened when relational trust is high. As Model 7 (Table 4) shows, the effect of organizational learning culture on OI is strengthened (β = 0.16, $p < 0.01$) at high levels of relational trust, thus supporting H3. Further, as shown in Table 5, the results of PROCESS macro using a 5000 bootstrap sample and bias-corrected 95 % confidence intervals were found to indicate that the index of moderated mediation does not contain zero (index = 0.05, 95 % bias-corrected CI [0.01, 0.10]). This suggested that the indirect effect of environmental dynamism on OI via organizational learning culture is stronger when relational trust is high (index = 0.17, 95 % bias-corrected CI [0.06, 0.30]) than when it is low (index = 0.04, 95 % bias-corrected CI [−0.02, 0.12]). Thus, H3 was confirmed. We created an interaction plot at ±1 standard deviation from relational trust to facilitate interpretation (Fig. 2).

Hypotheses 4a and 4b proposed a conditional effect of relational trust on the organizational learning culture–OI relationship based on industry sector and firm size, respectively. Model 8 (Table 4) shows that the moderating role of relational trust in the indirect effect of environmental dynamism on OI through organizational learning culture was found to be moderated by the industry sector (β = −0.20, $p < 0.05$) and firm size (β = 0.23, $p < 0.01$), thereby confirming both H4a and H4b, respectively. As shown in Table 5, the index of moderated mediation the for industry does not contain zero (index = −0.08, 95 % bias-corrected CI [−0.17, −0.02]) suggesting that high levels of relational trust strengthen the indirect effect of environmental dynamism on open innovation through organizational learning culture for low-technology firms (index = 0.04, 95 % bias-corrected CI [0.03, 0.18]) as compared to high-technology ones (index = 0.02, 95 % bias-corrected CI [−0.03, 0.07]). Furthermore, firm size was found to interact with relational trust to moderate the indirect relationship between environmental dynamism and OI (index = 0.04, 95 % bias-corrected CI [0.03, 0.18]), so that the contingent relationship is stronger for medium firms (index = 0.04, 95 % bias-corrected CI [0.04, 0.18]) than it is for small ones (index = 0.02, 95 % bias-corrected CI [−0.03, 0.05]). Fig. 3a shows the interaction effect of organizational learning culture, relational trust, and industry sector, whereas Fig. 3b demonstrates the interaction between organizational learning culture, relational trust, and firm size.

We performed supplementary analyses to confirm the robustness of our findings. The underlying multidimensional conceptualization of environmental dynamism involves the assumption that the individual dimensions are closely connected and act as a consistent bundle (Jaworski and Kohli, 1993). To empirically explore the consequences of analyzing multiple versus single environmental dynamism types, we estimated three additional structural models, one for each dimension separately. The results showed that only market turbulence (β = 0.35, $p < 0.001$) and technological turbulence (β = 0.27, $p < 0.001$) have a significant impact on organizational learning culture, which, in turn, significantly impacts OI (β = 0.36, $p < 0.001$). In addition, we found support only for the mediation effect of organizational learning culture on the relationship between technological turbulence and OI (β = 0.08; CI = [0.03, 0.14]). Thus, the notion that its 'bundle nature' is what makes environmental dynamism relevant to OI via organizational learning culture was found to be empirically supported.

Table 5
Results of mediation and moderation effects using PROCESS macro (5000 bootstrap samples).

Relationships	Effect	Standard error	95 % confidence internal	
			LLCI	ULCI
Indirect effect of environmental via organizational learning culture				
Direct effect of environmental dynamism	−0.33	0.07	−0.46	−0.20
Indirect effect of environmental dynamism	0.11	0.04	0.04	0.20
Conditional indirect effect of environmental via organizational learning culture for relational trust				
Index of moderated mediation	0.05	0.02	0.01	0.10
−1 standard deviation	0.04	0.04	−0.02	0.12
+1 standard deviation	0.17	0.17	0.06	0.30
Conditional indirect effect of environmental via organizational learning culture for relational trust and industry				
Index of moderated mediation	−0.08	0.04	−0.17	−0.02
−1 standard deviation	0.10	0.04	0.03	0.18
+1 standard deviation	0.02	0.02	−0.03	0.07
Conditional indirect effect of environmental via organizational learning culture for relational trust and firm size				
Index of moderated mediation	0.09	0.04	0.03	0.18
−1 standard deviation	0.01	0.02	−0.03	0.05
+1 standard deviation	0.10	0.04	0.04	0.18

Note. 5000 bootstrap samples for bias corrected bootstrap confidence intervals; LLCI = lower limit confidence interval; ULCI = upper limit confidence interval.

5. Discussion and conclusion

Previous literature has long acknowledged the importance of OI for ESMEs (Markovic et al., 2021; Marzi et al., 2023; Tsai et al., 2022). However, research on the risks and uncertainties that cause OI failure remained limited (Purdy et al., 2023). The findings of this study support the contextualized approach and highlight that environmental challenges can cause OI failure. Specifically, our findings recognized the differential effects of environmental dynamism on OI as a function of the mediating role played by organizational learning culture and of the moderating roles played by relational trust, industry sector, and firm size. We show that environmental dynamism is negatively related to OI (Dyer et al., 2018), which implies that the highly dynamic environments found in emerging markets could lead to a lack of transfer of external knowledge, thus negatively affecting OI activities. To overcome the negative consequences of environmental dynamism, ESMEs need to develop an organizational learning culture, specifically as an important mediating mechanism for the relationship between environmental dynamism and OI. These findings support previous work focused on the importance of organizational learning in the internal sharing of information and on changes in managerial behavior aimed at supporting external knowledge exchanges for OI (Hanvanich et al., 2006; Levitt and March, 1988; Yu et al., 2013). Those ESMEs that possess stronger organizational learning cultures overcome any environmental pressures and avoid the loss of relevant knowledge, which helps them pursue OI.

However, significant differences were found in the optimal level of an organizational learning culture as a function of relational trust levels (high vs. low). Our findings indicate that high levels of relational trust require a stronger organizational learning culture to develop the managerial skills needed to maximize OI activities. More importantly, the moderating role played by relational trust is contingent on industry sector (low- vs. high-tech) and firm size (small vs. medium firms). First, we found that low-tech industry sectors, characterized by intangibility, require higher levels of relational trust to strengthen the impact of organizational learning culture on OI. This result corroborates the view that low-tech industry sectors need greater relational norms (i.e., trust) to maximize their OI given the challenges they face and their low R&D

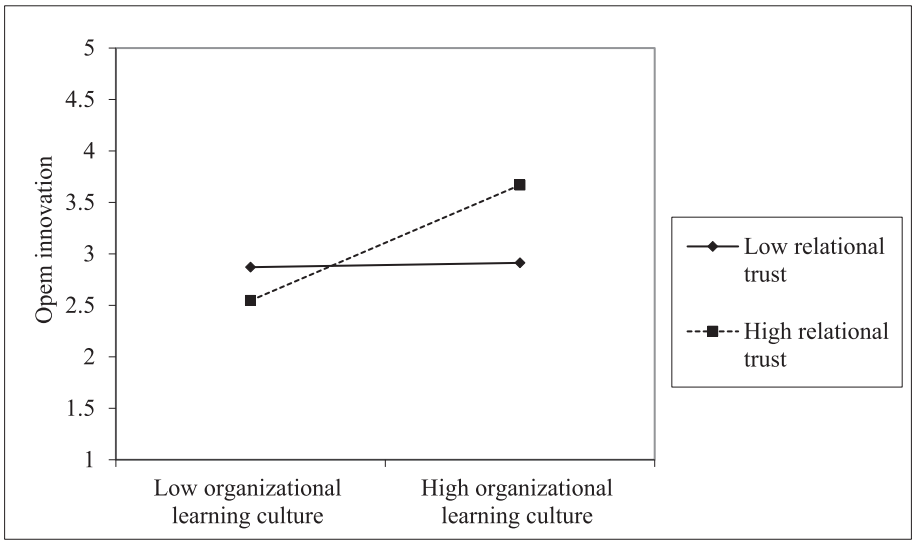

Fig. 2. Two-way interaction among organizational learning culture and open innovation.

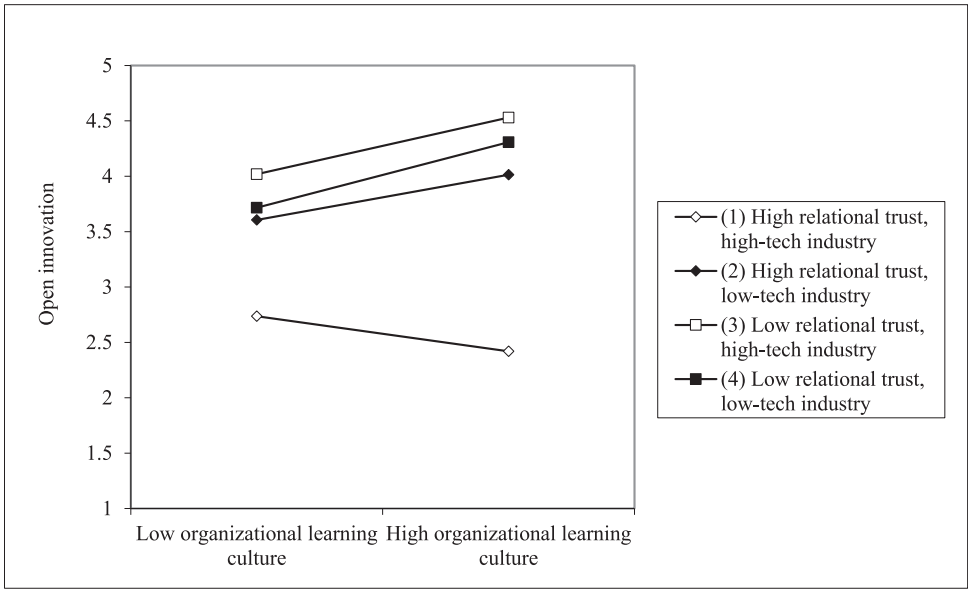

Fig. 3a. Three-way interaction among organizational learning culture, relational trust, and industry type.

capability (Mina et al., 2014; Ovuakporie et al., 2021). Second, we found that medium firms require high levels of relational trust to promote the relationship between organizational learning culture and OI. This is consistent with the view that such firms are engaged in external knowledge transfer more than their small counterparts (Mei et al., 2019; van de Vrande et al., 2009).

6. Theoretical implications

Our study offers several theoretical implications that improve our understanding of the effects of environmental dynamism on ESME OI. First, there has been limited scholarly attention devoted to understanding the implications of environmental dynamism for ESMEs' OI (Zahoor and Al-Tabbaa, 2020). We contribute to this line of research (Ahn et al., 2016; Nambisan et al., 2018; Pervan et al., 2015) by theorizing and testing both the direct and indirect effects of environmental dynamism on IO, thus offering a theoretical framework and empirical evidence suited to better understand the effect of environmental dynamism on OI in ESMEs. In this regard, our study hypothesized and found that environmental dynamism is negatively related to OI. The frequent shifts in technology, competition, and demand make it difficult for ESMEs to adapt their alliance tasks and thus reduce the relational rents for OI (Schilling, 2015). This is consistent with the relational view, suggesting that "*dynamic environments characterized by discontinuous change will have adverse effects on value creation in established alliances*" (Dyer et al., 2018, p. 3154). The prevalence of environmental dynamism hinders the adaptation in intense interdependent relationships, thereby resulting in reduced OI activities.

Second, our findings contribute to our understanding of the mechanisms of OI (Alassaf et al., 2020; Bhatti et al., 2021). By drawing key insights from learning theory (Garvin, 1993; Schon, 1983), we considered organizational learning culture as an important mechanism that allows ESMEs to overcome environmental constraints by relying on internal knowledge and learning systems to support OI activities. Despite the consensus on the support provided by the value of external knowledge exchange on OI (Bican et al., 2017; Gentile-Lüdecke et al., 2020; Hannen et al., 2019), far less is known about how and when ESMEs achieve OI in dynamic environments such as those found in emerging

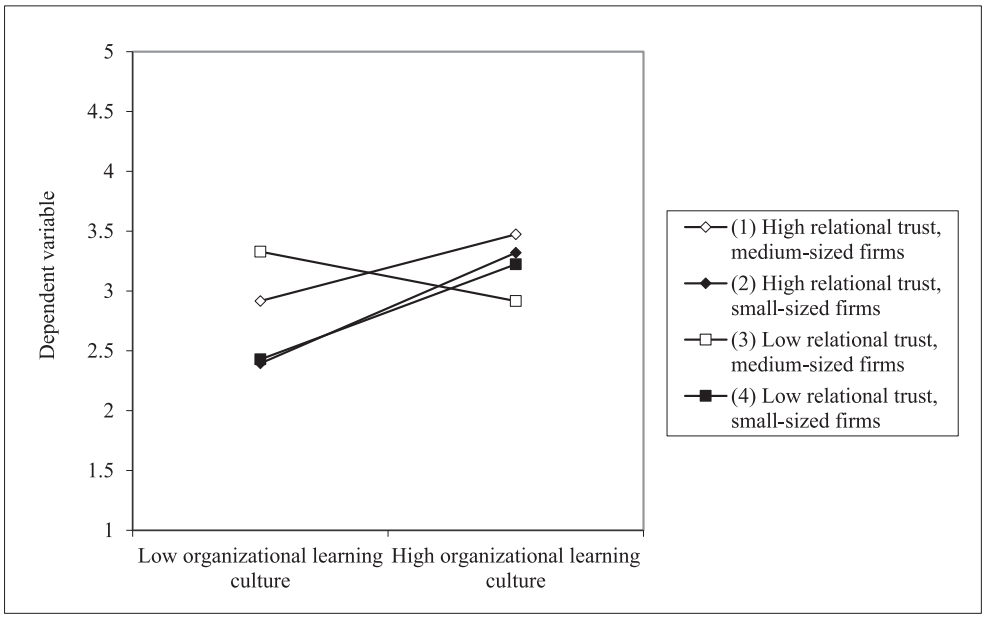

Fig. 3b. Three-way interaction among organizational learning culture, relational trust, and firm size.

markets. As a mechanism suited to translate external shocks into productive joint innovation activities, organizational learning culture plays a critical role in this process. The prevalence of environmental dynamism in emerging markets leads to strong organizational learning cultures, ultimately leading to OI. Thus, our findings confirm that organizational learning culture is an important mediating mechanism that links environmental dynamism with OI.

Third, our study extends the theoretical assumptions of relational capital (Nahapiet and Ghoshal, 1998; Saparito et al., 2004) by examining relational trust as an important moderating factor in explaining the conditions under which organizational learning culture improves OI activities in emerging markets. We argued that, although organizational learning culture may enable ESMEs to pursue joint innovations, such knowledge exchange efforts may be more or less influential on OI, depending on relational trust (Krishnan et al., 2016; Parente et al., 2020). Our findings indicate that the effect of organizational learning culture on OI is strengthened when relational trust is high. This finding extends the IO literature, particularly regarding ESMEs, given their exposure to weak institutional environments and greater degrees of environmental dynamism (Adomako et al., 2018).

Finally, our focus on the contingency role played by industry sector and firm size offers an important contribution to the OI literature. We demonstrated how relational trust moderates the relationship between organizational learning culture and OI based on industry sector (low- vs. high-tech) and firm size (small vs. medium). Our findings show that the ability of organizational learning culture to improve OI is stronger when the alliance partners have a stronger relational trust in low-tech industry sectors and medium firms. This could be due to the intangible nature of low R&D capabilities, which may require greater levels of relational ties for the exchange of much fine-grained know-how aimed at developing innovative technologies. These results explicate the industry sector- and size-based effects that underpin the OI outcomes of ESMEs (Mei et al., 2019; Ovuakporie et al., 2021).

7. Managerial implications

Our research provides insights into how the key decision-makers of ESMEs achieve excellence in the OI paradigm. Due to information asymmetry and lack of knowledge about foreign partners, engaging in OI activities can be a costly process for firms operating in emerging markets. First, while research has identified several determinants of ESME OI (Bhatti et al., 2021; Poppo et al., 2016), it has fallen short of identifying the factors that deteriorate OI activities. As our findings show that environmental dynamism negatively affects OI, we would suggest the need for ESME managers to be aware of their market environment, as high levels of environmental dynamism can make it difficult for them to communicate and coordinate OI tasks with their external partners.

Second, our findings show that to overcome the negative consequences of environmental dynamism on OI, ESMEs should develop an organizational learning culture to promote the managerial capabilities and learning behaviors needed to effectively share and exchange information. The development of a culture in which learning is encouraged and rewarded can develop the interest of managers in generating new ideas and experimenting with them (Surdu and Narula, 2020). In turn, an organizational learning culture can promote the excellence of the OI activities of ESMEs. Thus, when experiencing environmental dynamism, ESMEs should invest in the establishment of an organizational learning culture suited to support the OI paradigm.

Finally, our findings suggest that relational capital is a vital moderating factor in the relationship between organizational learning culture and OI. ESMEs should thus map their internal levels of individual trust propensity; this could help them to recruit and select employees that fit their desired levels of trust. This would not only promote their reputations but also help in establishing long-lasting relationships with external partners. Managers could also enact socialization mechanisms, such as company visits, to support the development of trust between collaborating partners. Additionally, ESMEs should provide internal supervision and training on nurturing alliance relationships, which can increase individual levels of trust propensity and knowledge sharing with alliance partners.

8. Limitations and future research directions

Despite its novel contributions, our study has some limitations that open up avenues for future research. First, the cross-sectional nature of our study precluded us from making causal claims. We would thus encourage future researchers to move beyond the cross-sectional research design in probing the dynamics of OI, relationships, and level of analysis. Second, our study is among the few to have examined the factors that could potentially hamper the OI activities of ESMEs (Bigliardi and Galati, 2018). Future studies could involve examining the

influence of other factors such as entrepreneur nationality, firm ownership, and governance OI practices. Another potential opportunity for future research involves considering factors at different levels—managerial, firm, network, and environmental—to examine the costs and failures of OI in terms of new product development and internationalization activities. Third, we found that the organizational learning culture-OI relationship is contingent on relational trust, industry sector, and firm size. Future studies focused on other moderating factors—such as knowledge complexity, entrepreneurial orientation, and institutional distance—may further deepen our theorizing contribution to the OI literature. For example, researchers could consider the role played by team leadership, organization communication, and international R&D managers for the organizational learning culture-OI nexus. Finally, the current research was conducted in UAE among ESMEs, which are prevalent in most emerging countries. It is important to consider the specific context of this study, as the findings may differ in more developed countries where resources are in abundance for small firms. Future studies could explore how the relationship between environmental dynamism, organizational learning culture, and open innovation differs in such contexts. While this study focuses on smaller firms, it is possible that larger companies with greater resources may have an advantage in developing open. Alternatively, smaller firms may be more adaptable and better able to assimilate and transform knowledge, which could lead to stronger effects of on open innovation. These are areas that require further investigation in future research.

Declaration of competing interest

Authors have no conflict of interest.

Data availability

Data will be made available on request.

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