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Open Innovation in Ecuadorian SMEs: The Importance of Strategy and the Moderating Effect of Control

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ABSTRACT Open innovation (OI) has been appointed as a key factor to promote innovative performance, but some research gaps remain especially when it comes to SMEs in developing countries. This article deals with (1) the effect of formalization of innovation strategy on OI activities in SMEs, (2) the impact of OI activities on SMEs' innovative performance, and (3) the moderating role played by control on the relationship between inbound and outbound activities and the innovative performance. OI encompasses a range of innovative methods and procedures in firms to stimulate internal innovation and widen the external use of innovation (inbound and outbound). In this work, an empirical study is carried out on 543 Ecuadorian SMEs. The results show that the formalization of the innovation strategy promotes OI activities, both inbound and outbound. While outbound activities carried out by SMEs enhance innovative performance, this positive effect is only identified for inbound open innovation activities when control exists and increases, acting this variable as a moderating factor. These results have important implications both for the management of companies and the development of public policies aimed at promoting OI in SMEs in developing countries. This research contributes to the literature as it deals with a developing country context and considers a wide range of OI activities.

KEYWORDS control mechanisms, developing countries, inbound and outbound innovation, innovation strategy, open innovation

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INTRODUCTION

Open innovation (OI) has become a research topic that has stimulated interest in business and academia in various disciplines recognizing the role played by SMEs (Sabando-Vera, Yonfa-Medranda, Montalván-Burbano, Albors-Garrigos, & Parrales-Guerrero, 2022; Santoro, Ferraris, Giacosa, & Giovando, 2018). In this sense, Bogers, Chesbrough, Heaton, and Teece (2019) advocate OI activities in

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SMEs as a vehicle for increased growth. OI is a strategic alliance that encompasses a range of innovative methods and procedures in firms to stimulate internal innovation and widen the external use of innovation to markets (Chesbrough, 2012; Spithoven, Vanhaverbeke, & Roijakkers, 2013). With a collaborative approach among strategic collaborators, the objective of OI is to adopt and take advantage of external knowledge, and internal ideas that are not generating value can be used by others (Bogers et al., 2019; Chesbrough, 2012). In short, as OI combines knowledge inflows and outflows (inbound and outbound OI processes) (Bogers, 2012), it promotes more expansive, cooperative, and attractive innovation for a broad diversity of players (West & Bogers, 2017). OI has the potential to manage innovation by joining complementary knowledge, skills, and ideas, sharing the risks and costs linked to the innovation process, and providing more effective results assessments by larger groups of actors (Kimpimäki, Malacina, & Lähdeaho, 2022).

Despite the relevance of OI as a key factor in entrepreneurial systems (Pustovrh, Rangus, & Drnovšek, 2020) and SME competitiveness, some papers state that there is a lack of empirical studies supplying valid knowledge about OI in SMEs (Bogers et al., 2019; Chesbrough, 2012; Greul, West, & Bock, 2018). The latest literature underlines the need to carry out studies on the variables that affect SMEs when moving from closed to OI (Barham, Dabic, Daim, & Shifrer, 2020; Duong, Voordeckers, Huybrechts, & Lambrechts, 2022; Grama-Vigouroux, Saidi, Berthinier-Poncet, Vanhaverbeke, & Madanamoothoo, 2020; Lyu, Zhu, Han, He, & Bao, 2020; Spithoven et al., 2013). Implementing successful OI activities in SMEs has several challenges: internal assets protection, management of external relations, relatedness, and business model innovation (De Marco, Martelli, & Di Minin, 2020). The theoretical framework around OI is the knowledge-based view that highlights the significance of the organization's knowledge characteristics, in addition to the organization's ability to integrate new external knowledge (Grant, 1996). The application of broader knowledge stock may not just disrupt existing organizational routines due to increased complexity of knowledge, but also escalate the cost of assimilating new knowledge (Leiponen & Helfat, 2010). In this scenario, OI activities do not always achieve the most effective innovation results (Hofstetter, Zhang, & Herrmann, 2018). Sometimes implementing costs related to OI activities are higher than the benefits linked to them (Bogers, Chesbrough, & Moedas, 2018). That is why researchers should look into factors that might facilitate/impede achieving a successful OI adoption by SMEs (Barham et al., 2020).

Due to OI characteristics, one important limitation that impedes effective results comes from the lack of a clear vision that limits strategic resources or strategic decisions related to the previous challenges (De Marco et al., 2020; Filiou, 2021; Tang, Fisher, & Qualls, 2021; Ullrich & Vladova, 2018) and makes it difficult for the alignment of OI activities with strategic objectives (Cavallo, Burgers, Ghezzi, & van de Vrande, 2021; Chesbrough, 2019). The role planning plays in promoting OI in SMEs has not been sufficiently addressed, even though such

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planning can be a key factor in promoting OI (Madrid-Guijarro, Martin, & García-Pérez-de-Lema, 2021). The formalization of the strategy has to do with the formal planning and written innovation activities, the existence of long-term innovation plans, and adequate coordination of innovation activities (Cândido & Sousa, 2017; Madrid-Guijarro et al., 2021; Majama & Magang, 2017; Sivam, Dieguez, Ferreira, & Silva, 2019). This concept is especially interesting to analyze as SMEs usually suffer from unclear innovation strategies (Müller, Buliga, & Voigt, 2021) or even the lack of strategic planning or formal planning because they frequently face situations where insufficient time is available for strategic issues (Edvardsson & Durst, 2013). The lack of rules and procedures dictated by the formalization of the strategy may result in the messy creation and integration of diverse knowledge (Chaudhary, 2019). The crucial role of the definition of strategy that allows integration of organizational knowledge through 'formal processes that ensure the capture, analysis, interpretation, and integration' of knowledge (Luca & Atuahene-Gima, 2007) should be present when defining innovation strategy. Literature reveals that the choice on whether to manage the knowledge-sourcing process with external parties formally or informally is contingent on the sources of knowledge involved (Du, Leten, & Vanhaverbeke, 2014; Gesing, Antons, Piening, Rese, & Salge, 2015). High levels of formalization promote the relationship between market-based partnerships and financial performance of innovation projects, as some firms have a competitive relationship with some suppliers and need measures to protect innovation projects from unwanted knowledge spillovers while sourcing external knowledge (Schultze, Prandelli, Salonen, & Van Alstyne, 2007). Furthermore, a formal collaboration approach increases the chance that new idea development will take place according to plan and that unfeasible suggestions from customers will be filtered out (Du et al., 2014).

Previous literature also highlights an important stream of research on innovation control systems (Saunila & Mäkimattila, 2018). The use of control systems can help SMEs to increase sales, improve customer satisfaction, and increase innovation performance (Brenes, Mena, & Molina, 2008). Control systems include performance evaluation, monitoring tools, and a culture of regular control and monitoring of progress (Brenes et al., 2008). In this article, control is defined following Cândido and Sousa (2017), including not only the knowledge and control of costs linked to innovation activities but also the use of indicators to monitor innovation activity performance along with technical and economic control of innovation activities. Through control, firms can identify their development, strengths, and weaknesses.

Through management, firms ensure compliance with innovation strategies and implementation of OI activities with long- or short-term measurements that allow SMEs to improve their competitiveness and performance (Akhmetshin, Vasilev, Mironov, Yumashev, Puryaev, & Lvov, 2018). However, Drechsler and Natter (2012) clarify that there is not yet a complete understanding of the effect control systems have on the performance of OI activities, and Carneiro, Farias,

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da Rocha, and Ferreira da Silva (2016) identify that managers make extensive use of economic/accounting metrics and little or no use of indicators related to innovation suggesting a possible short-term perspective. Consequently, there are an important number of papers that ask for an additional study about the effects of innovation control (Chesbrough & Appleyard, 2007; Rubera, Chandrasekaran, & Ordanini, 2016; Saulina, 2017; Saunila & Mäkimattila, 2018).

The scarcity of empirical papers on the effect of OI planning in SMEs and the role played by control mechanisms is even more evident in the case of companies in developing countries or Latin America (Brenes, Montoya, & Ciravegna, 2014; Cirera & Muzi, 2020). Although promoting innovation in Latin America is a key priority to enhance economic prosperity, the region is struggling to bring innovation to the forefront. Innovation in emerging markets mostly deals with incremental changes to implement existing practices and technologies (Perez-Aleman, 2011; Pietrobelli & Rabellotti, 2011). McDermott and Pietrobelli (2017), grounded on the theories of knowledge transfer, discuss how innovation for SMEs in Latin America depends largely on certain types of knowledge which might come from different types of network structures or sources.

Latin American context is worth noting. Latin America benefitted from a period of relative political stability and economic growth between the 2000s and mid-2010s, as a result of the reforms implemented during the 1990s and increase in prices in the commodities it exports (Brenes, Haar, & Requena, 2009; Ciravegna, Fitzgerald, & Kundu, 2014). However, from 2014 to 2016, as a result of the decrease in commodity prices, emerging economies' contribution to world economic growth deteriorated abruptly, reducing the attractiveness of Latin America, with its comparative advantage in natural resource-based products (Brenes, Camacho, Ciravegna, & Pichardo, 2016). Resource-based product dependency implies that the manufacturing of products not related to commodities declined as a share of Latin America's output. With growth deceleration, it is harder for firms to be profitable. Only those who invest in innovation, differentiate their strategies and establish collaborations with multinational firms, government agencies and other types of organizations can develop their capabilities to compete (Brenes et al., 2016). Cuervo-Cazurra et al. (2019), in the Latin American context, identify that some firms have been able to break away the focus on price with low-quality products and develop uncommoditizing strategies using innovation.

In emerging economies, SMEs have limited resources as well as a basic supply chain. Caballero-Morales (2021) identifies innovation as a key recovery factor for SMEs in these economies because it allows SMEs to equip themselves with the skills and tools to continue operating and maximize growth opportunities. Innovation allows them to modernize its operations for economic development (Markovic, Koporcic, Arslanagic-Kalajdzic, Kadic-Maglajlic, Bagherzadeh, & Islam, 2021). Therefore, analyzing innovation in emerging economies is important, because it is widely suggested as one of the most effective strategies to respond to crises

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and to improve their performance (Wenzel, Matthias, & Lieberman, 2020). Perez-Aleman (2011) highlights two relevant points about the Latin American context that somehow can affect innovation at SMEs. First, she points out the technological disadvantage suffered by firms in late-developing economies (knowledge and resource disadvantages) being depending on learning. Second, the Latin American context is characterized by a low-income environment where there are coordination problems, lack of infrastructure, and government assistance and technical services. All these factors involve a real challenge when many actors need to act in simultaneous and complementary changes aimed at gaining a competitive advantage based on innovation.

Though approaches to the topic of innovation appear in the 'Bogotá Manual' for Latin America (Jaramillo, Lugones, & Salazar, 2001) and the manual of 'Innovation and regional specialization in Latin America' (Barroeta, Paton, Palazuelos, & Giraldez, 2017; Navarro & Olivari, 2016), there is a deficiency of innovation data on developing countries (Bortagaray, 2016), and absence of a standardized methodology in innovation issues for these types of economies is evident (Castro, Flores, & Rajadel, 2017). The purpose of this research is (1) to analyze how the formalization of innovation strategies affects innovation activities in Ecuadorian SMEs, (2) to verify whether inbound and/or outbound OI activities affect innovative performance in Ecuadorian SMEs, and (3) to study the moderating effect control measures have on the influence of OI activities on innovative performance. Innovative performance is the 'contribution of product and process innovation to a firm's economic performance' (Meeus & Oerlemans, 2000: 47). In this sense, innovative performance includes the ability to introduce new products/services, its effect on sales, and efficiency.

Ecuador is especially interesting for this research since it is a country at mid-stage in its development, very dependent on natural resources, and interested in promoting industrial growth (Castro et al., 2017). One of the most important challenges for this country is to add value to its productive matrix through highly innovative products (Espinel, 2014). However, accomplishing sustainable growth can be delayed by an overreliance on commodity exports, and a failure to develop appropriate innovation systems that respond to dynamic changes in competitiveness (Anand, McDermott, Mudambi, & Narula, 2021). Considering all these characteristics, more research on the main factors that contribute to implementing OI in Ecuadorian SMEs is needed.

To tackle the main aims of this article, an empirical study is developed on 543 Ecuadorian companies. The proposed structural model is estimated by partial least squares. The findings show that the formalization of strategies favors the performance of OI activities in Ecuadorian SMEs. Outbound activities positively affect innovative performance of the company, while there is a moderating effect of the control of innovation on the relationship between inbound activities and innovative performance of Ecuadorian SMEs. In general, the results have important implications for SME management and Public Administrations. Thus, SMEs

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that wish to obtain competitive advantages through innovation must be aware that they have to carry out strategic formalization to promote OI activities that result in improved innovative performance. In turn, they must include control mechanisms to benefit from all the effects associated with inbound innovation activities. These results are also relevant in the design of public policies that seek competitiveness through OI in SMEs.

This study contributes to the literature in several aspects. First, it provides a comprehensive approach where OI is examined in a context of an emerging country. It is important to contextual innovation in the field of emerging markets (Bahar Kaya, Abubakar, Behravesh, Yildiz, & Sani Mert, 2020; Beltramino, Garcia-Perez-de-Lema, & Valdez-Juarez, 2021). These markets are characterized by their relatively low levels of innovation (Heredia-Pérez, Geldes, Kunc, & Flores, 2018), clients are more sensitive to prices (Derbyshire, 2014), and institutions play a very important role in their strategic processes (Stock, Greis, & Fischer, 2002). As pointed out by Gassmann (2006), broad context-related characteristics (such as degree of globalization, degrees of technological intensity and technology fusion, and knowledge leveraging) can modify the efficiency of collaborative efforts on innovation. Although there are studies in other emerging regions (Bahar Kaya et al., 2020), there are still very incipient studies in the reality of Ecuador, which has characteristics that make the study of OI in this region interesting such as less-aligned innovative structures and systems (Castro et al., 2017). Second, it considers a broad variety of OI activities, distinguishing between inbound and outbound activities, which allows more specific conclusions to be drawn about the situation of SMEs. The research gap identified by Greul et al. (2018) is also filled by simultaneously considering the use of both types of OI activities. Third, this work contributes to reducing the limits and risks organizations face when innovating. In doing so, it expands the research on the importance of implementing OI as a strategy that helps improve the performance of SMEs in developing countries (Chesbrough, 2003; Gentile-Lüdecke, Torres de Oliveira, & Paul, 2020; Wang, Chang, & Shen, 2015).

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

OI is an 'innovation process based on knowledge flows intentionally managed across organizational boundaries' (Chesbrough, 2003: 34) that seeks to accelerate innovation in the market. According to Chesbrough and Appleyard (2007), SMEs can take advantage of OI to expand their internal innovation by adopting external innovations. The use of OI tools promotes innovation in SMEs in a shared way (Harel, Schwartz, & Kaufmann, 2019; Lichtenthaler, 2008a). The collaborative framework of OI implies a change in the traditional innovation processes of companies (Sivam et al., 2019). Thus, OI facilitates the use of other companies' capabilities in the management of innovative processes (Lichtenthaler, 2008b), favors the

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integration of external networks to develop new products (Sisodiya, Johnson, & Grégoire, 2013), and transfers external knowledge in a collaborative way (Chesbrough & Appleyard, 2007; Schneckenberg, 2015; Sisodiya et al., 2013). Companies can offer their internal knowledge (Rosa, Mello, Chimendes, & Amorim, 2020) and at the same time as they integrate knowledge that has been generated by other companies. As pointed out by Chesbrough (2003), developing a collaborative business model with OI increases long-term innovation in the market.

The literature distinguishes two types of OI activities: (1) acquisition of external technology (inbound) and (2) exploitation of internal technology (outbound) (Bogers et al., 2018; Chesbrough & Crowther, 2006). Inbound activities include customer and external network participation in innovative processes, R&D outsourcing, and internal intellectual property (IP) licenses (van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Network collaborations allow businesses to compensate for inefficiencies in regulatory and judiciary systems by relying on long-term relationships based on reciprocity and allow firms to reduce the risk of opportunism without having to internalize transactions (Brenes, Ciravegna, & Pichardo, 2019). Universities and public–private R&D, training centers, and trade associations can enhance technological change and the implementation of new practices (McDermott, Corredoira, & Kruse, 2009). Outbound activities include 'the creation of new organizations, external licenses of IP, and the participation of non-R&D workers in innovation initiatives' (van de Vrande et al., 2009: 424). The theoretical framework around OI is the knowledge-based view that highlights the significance of the organization's knowledge characteristics, in addition to the organization's ability to integrate new external knowledge (Grant, 1996), knowledge is the masterpiece. OI accepts that knowledge that enhances innovations is anywhere in a company's value chain (Chesbrough, 2003). Since knowledge is an idiosyncratic good, transactions are complex and require specific skills (Teece, 2000). Knowledge management comprises the use of mechanisms that help companies to manage knowledge as an asset that promotes business development (Zemaitis, 2014). This article is focused on two steps of the OI process proposed by Lichtenthaler (2007), planning and control.

Innovation Strategies and OI Activities in SMEs

Formally developed strategy and long-term vision help the organization to detect implementation discrepancies and priorities, and ease organizational alignment around a clear message (Brenes et al., 2008). The formalization of innovation strategies favors the development of scientific, technological, organizational, financial, and commercial activities that lead to the implementation of successful innovations. Defining and communicating the innovative objectives to be pursued lead to designing appropriate inter-organizational policies and networks (Cândido & Sousa, 2017). Also, as pointed out by Bowonder, Dambal, Kumar, and

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Shirodkar (2015), in these cases, CEOs promote long-term success strategies in their companies. Planning allows companies to have a vision of the future to predict and face opportunities and threats that can arise in their environments (Chesbrough & Appleyard, 2007; Stonehouse & Pemberton, 2002). Therefore, the formalization of these strategies represents an important approach for those who wish to lead the market through innovation. The clear majority of successfully implemented strategies include formal planning (Brenes, Ciravegna, & Woodside, 2017). This fact is even more important for smaller firms because as highlighted by Corredoira and McDermott (2020) even though diverse knowledge can be crucial for innovation, SMEs can have an inadequate understanding of which new knowledge is most pertinent to improve their innovative capabilities.

OI activities have certain characteristics that make the formalization of innovation strategies necessary. OI involves the search for partners and accepting risk, uncertainty, and exchange (Kratzer, Meissner, & Roud, 2017; Sivam et al., 2019). Working with a multitude of partners can lead to management problems and entail significant cost (Du Chatenier, Verstegen, Biemans, Mulder, & Omta, 2009; Sieg, Wallin, & Von Krogh, 2010). In addition, absorbing knowledge from different sources can be very challenging (Gentile-Lüdecke et al., 2020). The integration of external knowledge in a company's own products (inbound) can lead to resistance known as the 'Not Invented Here' syndrome (van de Vrande et al., 2009). On the other hand, Dahl and Pedersen (2004) point out that outbound activities also involve important challenges since they are affected by the imperfections of the technology market and lack of internal process formalization.

The formalization of an innovation strategy that is aligned with a company's strategy facilitates the development of structures, horizontal and vertical channels of knowledge communication within the company, active listening from outside boundaries of the company (Sivam et al., 2019), and commitment of all the company's members. van de Vrande et al. (2009) identify innovation strategies as key elements in establishing successful collaborations with stakeholders, allowing a change in the business model that favors openness. The formalization of innovation strategies helps prevent risks and barriers to innovation and contributes to the successful economic growth of SMEs in the long term in different competitive markets. Sivam et al. (2019), through a survey, addressed Portuguese researchers, and concluded that the formalization of an innovation strategy is one of the main antecedents to OI in SMEs. These authors advocate the improvement of SME innovation strategies through action plans and medium- and long-term objectives. Du Chatenier et al. (2009) point out that if an OI project is not properly planned, this weakness can cause great difficulties. Brunswicker and Ehrenmann (2013) conclude that German SMEs integrate innovation practices that seek growth based on planning. Cândido and Sousa (2017) find that those Brazilian SMEs that formalize their strategy are more likely to implement OI. While Mamula and Popovic-Pantic (2015) observe that Serbian SMEs with strategic planning can present successful

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innovation projects with greater confidence. If a firm proactively manages knowledge inflows and outflows, it can strategically leverage a multitude of new strategic options (Kutvonen, 2011).

Based on this evidence, we identify the need to consider the different types of OI activities as they involve different risks ('Not Invented Here' syndrome vs. imperfections of the technology market), and propose the following hypotheses:

Hypothesis 1a: The formalization of an innovation strategy positively affects outbound OI in SMEs.

Hypothesis 1b: The formalization of an innovation strategy positively affects inbound OI in SMEs.

Open Innovation and Innovative Performance in SMEs

Inbound OI practices are crucial to achieving a sustainable competitive advantage (Chesbrough, 2003; Hung & Chou, 2013; Sisodiya et al., 2013). The search for external sources establishes connections with commercial and scientific partners, creating advantages over the competition (Gambardella & Panico, 2014; Tsinopoulos, Yan, & Sousa, 2019). This practice aims to acquire novel ideas for the development of new products (Hung & Chou, 2013; Parida, Westerberg, & Frishammar, 2012), increasing SME sales and growth (Ritala, Olander, Michailova, & Husted, 2015; Rubera et al., 2016; Stephan, Andries, & Daou, 2019).

Inbound innovation helps SMEs solve problems that arise in the integration and creation of ideas among individuals or organizations (Lee, Fong, Barney, & Hawk, 2019). Inbound innovation helps SMEs to manage specialized and complex knowledge (Lee, Lee, & Garrett, 2019), increasing the likelihood of boosting innovative performance at the organizational level (Kafouros, Love, Ganotakis, & Konara, 2019; Kim, Kim, & Foss, 2016).

Previous empirical evidence has shown a positive relationship between inbound OI and SME performance (Wang et al., 2015). Parida et al. (2012) report that inbound OI activities, like the acquisition of technology, are necessary to increase innovative performance. D'Angelo and Baroncelli (2020) conclude that Italian companies that have an inbound OI model based on R&D collaboration with universities and research centers and other private companies report positive results in both the development of new products and innovative performance. The analysis by Jasimuddin and Naqshbandi (2019) on a sample composed of French managers reveals that the alliance with the external knowledge of contracted research centers can help SMEs develop innovative capabilities. Considering the Latin American agribusiness, Brenes et al. (2014) obtained that innovation capabilities which include the company's relation with universities have a direct effect on the way a firm is perceived by its clients, and thus also on the clarity of its

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positioning in the market. In this sense, McDermott and Pietrobelli (2017) suggest that to upgrade SME capabilities we cannot forget that certain nonmarket institutions can act as social and knowledge bridges. Based on the previous reasoning, inbound activities in Ecuadorian SMEs are expected to influence innovative performance positively.

Hypothesis 2a: Inbound OI positively affects innovative performance in SMEs.

Outbound OI is the outbound movement of ideas and knowledge based on technological development and external connection among different companies that influence the innovative performance of SMEs (Lee, Fong, et al., 2019; Lichtenthaler, 2008b, 2015). The exploitation of knowledge allows SMEs to commercialize IP assets that are underused or not used in their companies, generating new ventures, external IP licenses, and collaboration with work teams (Bianchi, Croce, Dell'Era, Di Benedetto, & Frattini, 2016; Bogers et al., 2019; Chesbrough, 2012; Enkel, Gassmann, & Chesbrough, 2009; van de Vrande et al., 2009). This type of activity promotes technological standardization in industries (Lichtenthaler, 2008a), leading to the creation of new businesses (Chesbrough & Garman, 2009; Hung & Chou, 2013). In addition, through outbound innovation, companies can sell their underused ideas to their partners (van de Vrande et al., 2009), which leaves SMEs free to focus on developing their internal capabilities and, therefore, outperforming their competitors (D'Angelo & Baroncelli, 2020; van de Vrande, Vanhaverbeke, & Gassmann, 2010). Outbound innovation models are crucial for SMEs as they minimize uncertainty since companies are already familiar with the projects (Popa, Acosta, & Conesa, 2017; Remneland Wikhamn & Styhre, 2019). Firm resources and experience are better aligned to outbound activities (Stephan et al., 2019). This makes a difference when it comes to reducing the time needed to launch a new product or service (Lee, Lee, et al., 2019) and decreasing the risk of obsolescence by increasing competitiveness (Laursen & Salter, 2006; Xin, Yeung, & Cheng, 2010). Therefore, the benefits of outbound innovation are presented as productivity gains, improvements in product quality, and savings in costs and time (Greco, Grimaldi, & Cricelli, 2016). These are benefits that can lead to a decrease in prices, an increase in sales, and, therefore, an improvement in SME innovative performance (Greul et al., 2018). Outbound innovation generates monetary and nonmonetary benefits from the commercial exploitation of internal knowledge and technologies and, at the same time, reduces the threats of competition (Popa et al., 2017). On the other hand, it is worth noting that this type of OI leads companies to assume the risk of transferring relevant knowledge, which could weaken their competitive positions. Consequently, companies that opt for these activities should avoid selling what is known as their *core knowledge* (Bianchi, Campodall'Orto, Frattini, & Vercesi, 2010; Dąbrowska, Fiegenbaum, & Kutvonen, 2013). Additionally, outbound

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activities entail greater challenges given the imperfections in the technology market (Lichtenthaler & Ernst, 2007).

Singh, Gupta, Busso, and Kamboj (2021) and Inauen and Schenker-Wicki (2012) found that outbound activities have a relevant impact on SMEs' innovative performance, especially through the generation of radical innovations. Lee, Park, Yoon, and Park (2010), in the Korean context, revealed that knowledge and technology transfers to other companies maximize the success of new products and services in the long term. Similarly, Bigliardi and Galati (2016) showed that internal knowledge exchange in open networks generates a collaborative environment that allows SMEs to undergo continuous improvement. They reported that new firms which establish alliances with others (outbound OI) increase the likelihood of profiting from their innovations without requiring commercialization capabilities. Based on the previous literature, we hypothesize the following.

Hypothesis 2b: Outbound OI positively affects innovative performance in SMEs.

Control of Innovation as a Moderating Variable in the Relationship Between Open Innovation and Innovative Performance

Control is based on formal rules, procedures, and standardized routines that facilitate the coordination of innovation projects (George, Walker, & Monster, 2019; Ylinen & Gullkvist, 2014). This includes the initial stages of innovation activities, monitoring their processes, implementation, and commercialization (Bisbe & Malaguenõ, 2015). Control systems are important evaluation tools to reduce potential errors and costs (Cui, Wu, & Tong, 2018) and technical and economic uncertainty (Akhmetshin et al., 2018; Bogers et al., 2019). The use of control systems can help SMEs increase sales, improve customer satisfaction, and increase innovation performance. Similarly, control exerts an effect on product innovation, investigating how different systems of control are related to different phases of innovation processes, which can have an important influence on creativity, coordination, and integration of knowledge, as well as on the filtering phases of innovation processes.

Inbound and outbound activities may require different controls, as they call for varying degrees of change due to a combination of environmental, organizational, managerial, and structural forces (Nguyen, Larimo, & Wang, 2019). With inbound OI activities, formal and standardized rules should be implemented with greater rigor (Bogers et al., 2019; Havlíček, Thalassinos, & Berezkinova, 2013; Ylinen & Gullkvist, 2014) as these activities are meant to change how firms develop their innovation (Parida et al., 2012). In contrast, outbound activities involve a lower level of uncertainty as firms are familiar with their internal knowledge (Burcharth, Knudsen, & Søndergaard, 2014; Chesbrough, 2016), and use external channels to generate added value (Laursen & Salter, 2006; Ylinen & Gullkvist, 2014). In this case, controls can be more flexible (Ylinen & Gullkvist,

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2014), keeping in mind that this control allows SMEs to share their internal knowledge and avoid the risk of sharing core knowledge (Akhmetshin et al., 2018; Havlíček et al., 2013; Lichtenthaler, 2009).

In general, controls lead to process improvements (Guo, Paraskevopoulou, & Santamaría Sánchez, 2019), make knowledge and skills more explicit, and reduce possible deviations (Benner & Tushman, 2003). In addition, control systems can be used to codify innovation practices, facilitating their efficient incorporation (Bedford, 2015; Ylinen & Gullkvist, 2014). Empirical research signals the positive influence innovation control has on OI activities affecting innovation performance (Nguyen et al., 2019; Saunila & Mäkimattila, 2018). Ylinen and Gullkvist (2014) demonstrate that the use of control systems associated with performance improvement in SMEs differ according to the types of innovation activities involved, and they are tools to define the resources necessary to carry out improvements and obtain benefits. Similar results are found by Guo et al. (2019) for the Spanish context. The following hypothesis is proposed:

Hypothesis 3a: The control of innovation moderates the effect of inbound innovation on innovative performance.

Hypothesis 3b: The control of innovation moderates the effect of outbound innovation on innovative performance.

Figure 1 shows the research model proposed by the previous hypotheses.

SETTING AND METHODS

Ecuadorian Context

Although Ecuador experienced a boom in both mining and construction, this economic boom helped the rise of political leaders who used government revenues to buy their popularity by expanding public sector investment and employment (Aguilera, Ciravegna, Cuervo-Cazurra, & Gonzalez-Perez, 2017). Fernández and Martin (2017) describe Ecuador as a lower-middle-income economy with a productive structure specialized in goods and services with low value-added and based, mainly, on the export of raw materials. SMEs are crucial for Ecuador, since they strengthen the value chain of large organizations (Peña & Vega, 2017), represent 95% of productive units, and generate around 70% of employment (Ron & Sacoto, 2019).

The National Innovation System of Ecuador has made the first approach to OI by promoting 'a network of institutions from the public and private sectors, whose interactions initiate, develop, modify, and commercialize new technologies' (Acosta & Kumar, 2015: 1). The objective of this initiative is to encourage organizations to implement research and development (R&D) (Fagerberg & Sapprasert,

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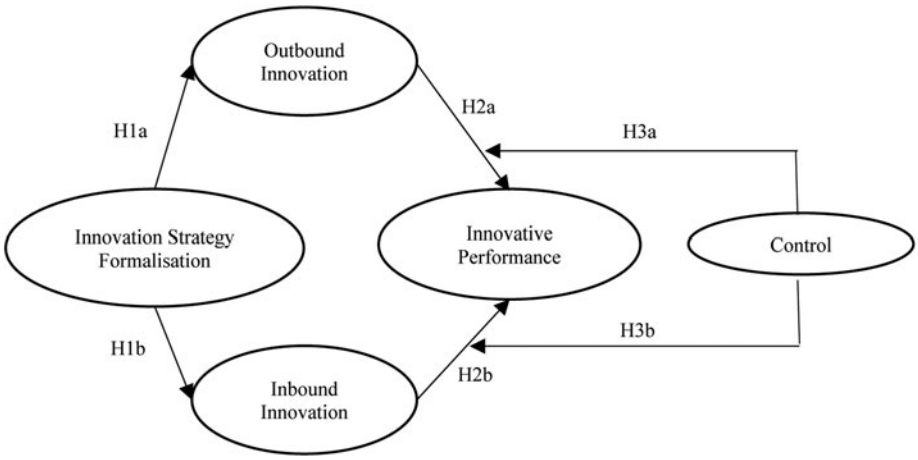

Figure 1. Research model

2011). However, Ecuadorian SMEs do not have the incentives or infrastructures to manage science and technology, nor do they have the human capital to guarantee the expansion of OI as a performance facilitator (Castro et al., 2017; Fernández & Martin, 2017). According to INEC (2019), 69.3% of Ecuadorian SMEs stated that they had not innovated in their organizations in the last three years, due to lack of knowledge, lack of technological resources, and organizational culture.

The absence of support from innovation centers and universities, and lack of infrastructures in Ecuador make its innovation system to be still at an emerging stage (Fernández-Sastre & Reyes-Vintimilla, 2020). Ecuador is considered one of the most entrepreneurial countries in Latin America among Chile, Colombia, and Peru, but the last in innovation according to the Global Innovation Index elaborated by Dutta, Lanvin, and Wunsch-Vincent (2020). This responds to the fact that in Ecuador, businesses arise out of necessity rather than an opportunity, avoiding turning a venture into an innovative and sustainable business over time. According to Zapata-Cantu and González (2021), about seizing capability, Ecuador ranks below 10 Latin American countries, among them Brazil, Chile, Mexico, and Costa Rica, and below 11 Latin American countries concerning its transforming capability. Fernández-Sastre and Vaca-Vera (2017) highlight the importance of non-R&D cooperative relationships as sources of innovation for the Ecuadorian context, revealing a positive influence of this type of relationship on the likelihood of introducing new products. This article used data from the Ecuadorian Survey of Innovation (ENAI) covering mainly large Ecuadorian companies. Research about how Ecuadorian SMEs is needed.

Sample

In this study, 543 CEOs of Ecuadorian SMEs were personally interviewed. The sample selection process was based on the principles of stratified sampling in

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finite populations discarding very small companies (fewer than five employees) and considering the segmentation by industrial activity. To compute the size of each stratum, information from the Ministry of Industries of Ecuador was used. Sample estimation contemplates in the worst case ($p = 0.5$), 3% maximum error with a 95% confidence level. The firms that refused to participate were substituted by similar companies selected at random. Sample distribution is reported in Table 1. The mean age of the firms in the sample is 17.96 years and the average number of employees (size) is 20.75.

Interviews with company CEOs were accomplished between September and December 2018, using a questionnaire. SME CEOs are approached because they are the main decision-makers in this type of firm (Brenes et al., 2008; Van Gils, 2005). The knowledge CEOs have significantly influenced the strategic behavior of an organization (O'Regan & Sims, 2008). Control tests were conducted during the process of preparing our survey. In addition, when developing the questionnaire, special care was taken to minimizing social convenience bias. Therefore, words associated with confidence-success were eliminated (Bstieler, Hemmert, & Barczak, 2015), special emphasis was placed on the validity of all answers (Yang, Zhang, Jiang, & Sun, 2015), and the confidentiality of the data was assured (Harms, 2015). In addition, we conducted a pre-test with five SME owners to verify a proper understanding of the questionnaire (Madrid-Guijarro et al., 2021).

Measures

Scales used in this research have been previously verified in the literature. Formalization strategy is measured considering a scale built of four items using a 5-point Likert scale (1: totally disagree, 5: totally agree). The items are: there is a formally defined innovation strategy (Brenes et al., 2008; Sivam et al., 2019), the company carries out formal planning and written innovation activities (Cândido & Sousa, 2017; Madrid-Guijarro et al., 2021; Majama & Magang, 2017), the company plans long-term innovation activities (Brenes et al., 2008; Majama & Magang, 2017; Sivam et al., 2019), and the company carries out adequate coordination of innovation activities (Sivam et al., 2019). To measure the Innovation Control variable, we used a scale with four items based on previous research. This scale considers control and knowledge of the costs of innovation (Cândido & Sousa, 2017), control of innovation activity performance through indicators (Majama & Magang, 2017), control of innovation activities through the role of budgets (Batra, Sharma, Dixit, & Vohra, 2017), and frequent technical and economic control of innovation activities (Majama & Magang, 2017).

To measure OI activities, an adaptation of the scale by van de Vrande et al. (2009) was used. Outbound innovation is built of three items: (1) starting a new business from the internal knowledge of the company itself, (2) the sale or offer of licenses or royalty agreements to other companies to obtain benefits from their IP, patents, copyright, or trademarks, and (3) the use of the knowledge of

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Table 1. Sample distribution

Industry	*Number of firms*
Food and beverage	35
Textiles	26
Wood and cork	20
Paper, publishing, and printing	22
Chemicals	23
Manufacture of rubber and plastic products	18
Other nonmetallic minerals	24
Basic and fabricated metals	34
Machinery and equipment	20
Electrical equipment, electronic, and optical	17
Manufacture of motor vehicles	20
Furniture	31
Construction	85
Wholesale Business	31
Hotel industry	31
Land, sea, and air transport	41
Computer services	16
Others	48
Total	543

and initiatives by employees who are not involved in R&D. Inbound activities are measured through three items: (1) the direct participation of clients in their innovation processes, (2) participation in new or established companies to obtain access to their knowledge or to obtain other synergies, and (3) the purchase of R&D services from other organizations, such as universities, public research bodies, commercial engineers, or suppliers. For the Latin American context, Brenes et al. (2014) highlighted 'company's relationship to academic organizations'. Innovative performance is measured by adapting the scales proposed by Gunday, Ulusoy, Kilic, and Alpkan (2011), Pino, Felzensztein, Zwerg-Villegas, and Arias-Bolzmann (2016), van de Vrande et al. (2009), and Wang et al. (2015). We consider the skill of introducing new products and services into the market in comparison with a firm's competitors, quality of new products and services, increase in sales due to new products, increase in sales caused by improved products, efficiency in delivery processes, both inside and outside of the company, and improved processes to save costs and time.

RESULTS

To estimate the proposed model, we use partial least squared estimations (PLS-SEM). This technique delivers reliability and validity of the measures and estimates the paths being superior to the multiple regression analysis (Barroso, Cepeda, & Roldán, 2010). Rigdon, Sarstedt, and Ringle (2017) explain that the technique has to be consistent with the model type established in the research. In this

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sense, when the research aims to estimate a factor model, researchers should use CB-SEM, while in a model of composites they should use a composite-based method such as PLS-SEM (Chin, 1998; Rigdon et al., 2017; Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016). Furthermore, when there is any hesitation about the nature of the construct, Sarstedt et al. (2016) recommend using PLS as this technique provides the least biased results. Composite indicators are the operational definition of the emergent construct (Henseler, 2015). This type of construct does not have an error term, acting as contributors to a construct instead of causing it (Bollen, 2011; Bollen & Bauldry, 2011). Composite indicators share the same consequences (Henseler, 2017), but they do not need to be unidimensional. Thus, composite indicators may represent different aspects relating to the construct. As clarified by Sarstedt et al. (2016), PLS uses Mode A and Mode B. Mode A links to the correlation weights derived from bivariate correlations between each indicator and the construct, while Mode B has to do with regression weights. Indicators of composite B constructs are not correlated. This technique is suitable in this research because we use composite types B and A in our model (Chin, 1998; Dijkstra & Henseler, 2011; Tenenhaus & Tenenhaus, 2011). OI activity constructs (inbound and outbound) are composite type B as their items identify different activities which do not need to be correlated. We analyze the moderating effect linked to the innovation control variable estimating three models using the orthogonalization method proposed by Henseler and Chin (2010). In model 1, we do not consider the innovation control variable. In model 2, we introduce the effect of the innovation control variable on the innovative performance of the company. Finally, in model 3, we consider the moderating effect of this variable on the relationship between OI activities and innovative performance. To test the hypotheses, we run 5,000 subsamples using the bootstrapping technique.

Measurement Model

Type A composite constructs. We proved the reliability and convergent validity of the type A composite constructs of the model considering: factor loads (value and significance), Cronbach's alpha, composite reliability (Chin, 1998), Dijkstra-Henseler rho ratio (Dijkstra & Henseler, 2015), and the average variance extracted (AVE) (Table 2). Our results reveal that three type A composite constructs (strategy, innovative performance, and innovation control) have items whose factor loads are above the minimum threshold of 0.707 (Carmines and Zeller, 1979), varying between 0.730 and 0.940 (p-value: 0.000). Cronbach's alpha is higher than 0.7 for all the constructs, reaching important levels, such as 0.948 for strategy, 0.914 for innovative performance, and 0.961 for innovation control. We find similar results when it comes to composite reliability (ρ_c) and Dijkstra-Henseler's ratio (ρ_A), which leads us to verify the reliability of the constructs; that is, their internal consistency (Cepeda-Carrion, Cegarra-Navarro, & Cillo, 2019). Following Fornell

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and Larcker (1981), we confirm that the level of the AVEs is equal to or higher than 0.5 for each construct. In this research, the AVE varies between 0.604 and 0.859.

Finally, we examine discriminant validity through the Fornell-Lacker criterion and the Heterotrait-Monotrait ratio (HTMT) proposed by Henseler, Ringle, and Sarstedt (2016) (Table 3). In our research, (1) the square root of the AVE of each construct is higher than the correlation with the rest of the constructs, verifying the criteria proposed by Fornell-Larcker, and (2) the HTMT between each pair of constructs varies from 0.261 to 0.814, which is below the proposed maximum of 0.85 (Henseler et al., 2016).

Type B composite constructs. The indicators used previously are not valid when we talk about type B composite constructs. In this case, we rely on the indicators' weights and their significance and on the variance inflation factor (VIF) among the indicators to examine the potential multicollinearity among them (Diamantopoulos & Siguaw, 2006; Table 2). The results reveal that all the weights are significant (two tails *T*-Student *p*-value: 0.000) which leads us to believe that all the indicators are relevant for the type B composite constructs. Furthermore, the factor loads are above 0.7 in all the cases. As the VIF is lower than 3 (Hair, Risher, Sarstedt, & Ringle, 2019), varying between 2.938 and 1.460, we confirm that there are no multicollinearity problems.

Structural Model

Coefficient values and their significance along with the value of the adjusted R^2 are individual measures of the explanatory power of the model (Chin, 2010). The significance of the relationships is performed with a bootstrapping analysis with 5,000 subsamples. The results of the three estimated models (Table 4) reveal that there is a positive and significant path between the formalization of innovation strategies on the performance of outbound activities (Model 1: 0.492, *p*-value: 11.302; Model 2: 0.492, *t*-value: 11.369; Model 3: 0.493, *t*-value: 11.340) and inbound activities (Model 1: 0.565, *t*-value: 17.159; Model 2: 0.565, *t*-value: 17.304; Model 3: 0.565, *t*-value: 17.221). These results verify hypotheses H1a and H1b. Given that the coefficients linked to the strategy-inbound activity relationship are higher than those obtained for the outbound activities, we can affirm that the effect of formally defining an innovation strategy affects the performance of inbound activities to a greater extent. While in the three models we find that outbound activities positively affect the innovative performance of SMEs (Model 1: 0.213, *t*-value: 2.353; Model 2: 0.184, *t*-value: 1.959; Model 3: 0.214, *t*-value: 2.259), this relationship is not significant for inbound activities when the variable control of innovation is introduced in the structural model (Models 2 and 3). In fact, in Model 1, the coefficient of this path is 0.147 with an adjusted significance since the *t*-value is 1.746, while in Models 2 and 3, this relationship is no longer significant, with associated *t*-values of 1.209 and 0.694, respectively. These

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Table 2. Measurement model

Indicators	*Constructs*		*Factor loads/ weights*	*(*p*-value)*
Innovation strategy formalisation composite type A Cronbach's alpha: 0.928; Dijkstra-Henseler's rho (ρ_A): 0.934; CR (ρ_c): 0.948; AVE: 0.821				
E1	We have a clearly defined innovation strategy		0.921	(0.000)
E2	Innovation activities are formally planned in writing		0.885	(0.000)
E3	Long-term innovation activities are planned		0.931	(0.000)
E4	The application of innovation activities is properly coordinated		0.887	(0.000)
Innovative performance composite type A Cronbach's alpha: 0.892; Dijkstra-Henseler's rho: 0.904; CR: 0.914; AVE: 0.604				
RI1	Ability to introduce new products and services into the market better than competitors		0.810	(0.000)
RI2	Quality of new products and services		0.759	(0.000)
RI3	Increase in sales generated by new products or services		0.824	(0.000)
RI4	Increase in sales generated by modified products or services		0.801	(0.000)
RI5	Efficiency in delivery processes inside and outside the company		0.746	(0.000)
RI6	Improved processes to save costs and time		0.768	(0.000)
RI7	Simplification of the operation by betting on best organizational practices		0.730	(0.000)
Control composite type A Cronbach's alpha: 0.946; Dijkstra-Henseler's rho: 0.960; CR: 0.961; AVE: 0.859				
C1	The costs of innovation are controlled and known		0.940	(0.000)
C2	The performance of innovation activities is monitored through indicators		0.926	(0.000)
C3	Budgets play an important role as control mechanisms for innovation activities		0.929	(0.000)
C4	Frequent technical and economic controls are carried out on innovation activities		0.914	(0.000)
Outbound Innovation activities composite type B		FIV	Factor loads/ weights	
OUT1	Starting a new business from internal knowledge of the company itself	1.822	0.821//0.322	(0.000)
OUT2	Sale or offer of licenses or royalty agreements to other companies to obtain benefits from their intellectual property, patents, copyrights, or trademarks	1.853	0.840//0.360	(0.000)
OUT3	Leverage of the knowledge and initiatives of employees who are not involved in R&D	1.611	0.874//0.495	(0.000)
Inbound Innovation activities composite type B				
INB1	Direct participation of customers in their innovation processes	1.460	0.846//0.494	(0.000)
INB2	Participations in new or established companies to gain access to their knowledge or to obtain other synergies	2.938	0.883//0.358	(0.000)
INB3	Purchase of R&D services from other organizations, such as universities and public research organizations	2.623	0.835//0.318	(0.000)

Notes: VIF, Variance Inflation Factor. SRMR 0.079; CR, Composite Reliability; AVE, Average Variance Extracted.

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Table 3. Measurement model. Discriminant validity based on Fornell-Larcker criterion (F-L) and HTMT ratio

F-L	*1*	*2*	*3*	*HTMT*	*1*	*2*
1. Strategy	0.906					
2. Innovative Performance	0.233	0.777			0.236	
3. Control	0.759	0.253	0.906		0.814	0.261

results verify hypothesis H2a but not hypothesis H2b. The influence of the innovation control variable on the effect of inbound activities on innovative performance was verified through the study of the moderating effect. Thus, Model 3 shows a significant and positive moderating effect (0.246, *t*-value: 2.622). Furthermore, it is relevant to highlight the large increase (from 0.12 to 0.19) that occurs in the adjusted R^2 linked to innovative performance when introducing this moderating effect in the model. This result leads us to consider that the establishment of innovation controls causes inbound innovation activities to have a positive effect on innovative performance that would not exist if these controls had not been established. The analysis of the f^2 following the heuristic rules by Cohen (1988) shows that in this model there is a strong effect of the formalization of strategies on inbound innovation activities (0.470), a moderate effect of strategies on outbound activities (0.322), and two weak effects regarding the relationships between outbound activities and innovative performance (0.021) and moderating effect of control on the relationship between inbound activities and innovative performance (0.026). Figure 2 shows the main results.

Since estimations of the path coefficients are made based on ordinary least squares regressions, we must avoid the presence of multicollinearity between the antecedent variables of each of the endogenous constructs. Therefore, we must analyze the multicollinearity between inbound and outbound innovation activities and the control of innovation activity since they are the antecedents of the endogenous construct of innovative performance. As Table 5 shows, in Model 3, the VIF values comply with that indicated by Hair et al. (2019) since they are less than 3.

Predictive Validity Using Hold-Out Samples

Following Shmueli et al. (2019), we include the analysis of the predictive validity of our model in samples not used for the estimation to evaluate the practical relevance of the model. To do this, we use the PLS predict analysis with ten sections and ten repetitions. First, since all the Q^2 of the PLS model are greater than 0 (Table 6), the prediction errors of the PLS model results are fewer than the prediction errors resulting from simply using the mean values. Therefore, our PLS model has better predictive performance (Shmueli et al., 2019). Second, we compare the

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Table 4. Structural models

Paths	*Model 1*	*Model 2*	*Model 3*	*Model 3* f^2	*Supported*
	Adjusted R^2 inbound: 0.242 R^2 outbound: 0.319 R^2 in performance: 0.116	Adjusted R^2 inbound: 0.241 R^2 outbound: 0.318 R^2 in performance: 0.119	Adjusted R^2 inbound: 0.242 R^2 outbound: 0.318 R^2 in performance: 0.193		
H1a: Formalization Innovation strategy-outbound innovation	0.492 (11.302)*** [0.411; 0.556]	0.492 (11.369)*** [0.410; 0.554]	0.493 (11.340)*** [0.410; 0.554]	0.322	Yes
H1b: Formalization Innovation strategy-inbound innovation	0.565 (17.159)*** [0.505; 0.614]	0.565 (17.304)*** [0.506; 0.614]	0.565 (17.221)*** [0.503; 0.613]	0.470	Yes
H2a: Outbound Activities-Innovative Performance	0.213 (2.353)** [0.052; 0.353]	0.184 (1.959)** [0.009; 0.320]	0.214 (2.259)** [0.054; 0.355]	0.021	Yes
H2b: Inbound Activities-Innovative Performance	0.147 (1.746)** [0.012; 0.274]	0.101 (1.209) [−0.040; 0.237]	0.058 (0.694) [−0.093; 0.186]	0.001	Partially
Control-Innovative Performance		0.130** (2.098)** [0.026; 0.230]	0.129 (2.164)** [0.028; 0.224]	0.016	
Moderating Effect H3a: ControlX*Outbound*-Innovative Performance			0.021 (0.244) [−0.134; 0.150]	0.000	No
Moderating Effect H3b: ControlX*Inbound*-Innovative Performance			0.246 (2.622)** [0.104; 0.416]	0.026	Yes

Notes: *t*-values in brackets. Bootstrapping 95% Confidence Intervals (bias-corrected) in square brackets (n = 5,000 subsamples). ***p = 0.001; **p = 0.01; *p = 0.05. Estimations considering size and age sector as control variables show similar results.

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Table 5. VIF value for inner model (Model 3)

	Outbound innovation	*Inbound innovation*	*Innovative performance*
Control			1.313
Outbound innovation			2.760
Inbound innovation			2.814
Strategy	1.000	1.000	

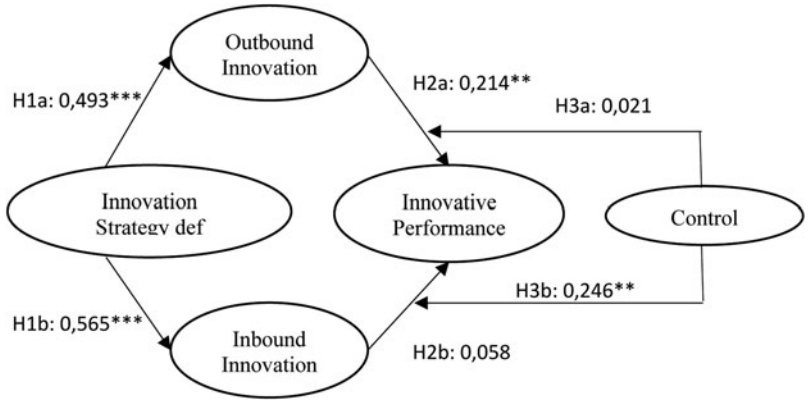

Figure 2. Model 3 results

Table 6. The predictive capacity of the model. PLS predict

	PLS-SEM		*LM*	
Indicator	*RMSE*	Q^2*_predict*	*RMSE*	*PLS-SEM-LM RMSE*
OUT1	1.066	0.201	1.035	0.031
OUT2	1.159	0.206	1.211	−0.052
OUT3	0.967	0.124	1.045	−0.078
INB1	1.059	0.279	1.026	0.033
INB2	1.149	0.249	1.181	−0.032
INB3	0.972	0.183	1.013	−0.041
RI1	0.823	0.116	0.861	−0.038
RI2	0.876	0.028	0.85	0.026
RI3	0.884	0.08	0.932	−0.048
RI4	0.886	0.104	0.908	−0.022
RI5	0.846	0.036	0.825	0.021
RI6	0.821	0.078	0.825	−0.004
RI7	0.868	0.074	0.895	−0.027

root values of the root-mean-squared error (RMSE) obtained in the PLS-SEM analysis and those obtained with a linear regression (LM) model that regresses all the exogenous indicators to predict each endogenous indicator. Our PLS model, supported theoretically through the hypotheses presented, produces

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fewer prediction errors for all the indicators except for 3. Therefore, according to Shmueli et al. (2019), our model has a medium predictive level.

DISCUSSION

OI is important for SMEs because it helps them to expand their limits both in the creation and commercialization of innovations (Greul et al., 2018; West, Salter, Vanhaverbeke, & Chesbrough, 2014). Some authors consider that OI is a necessity for SMEs because it strengthens their resources and supplies missing assets (Brunswicker & Vanhaverbeke, 2015; De Marco et al., 2020). However, openness involves certain risks and costs (Dahlander & Gann, 2010; Enkel et al., 2009) that need to be assessed and controlled. This study analyses whether formalising innovation strategies helps SMEs to carry out inbound and/or outbound OI activities, in addition to the effect that control measures have on innovation performance. Based on a survey of 543 Ecuadorian SMEs, results indicate that formalisation is positively associated with the performance of inbound and outbound activities in Ecuadorian SMEs. Latin American OI is still very underrepresented in strategic formalization studies (Aulakh, Kotabe, & Teegen, 2000; Nicholls-Nixon, Davila, Sanchez, & Rivera 2011); especially in countries such as Ecuador, where OI is a limited and little-explored topic (Fernandez-Sastre & Vaca-Vera, 2017; Santos, 2015).

Among the variables that make this study interesting is Ecuador's need to reduce poverty at the national level and mainly in urban and rural areas where SMEs with low innovation indicators are located (INEC, 2021). Latin America is a special scenario because most countries have gone through extensive economic, political, and regulatory structural reforms (Borda, Geleilate, Newburry, & Kundu, 2017; Brenes, 2000; Cuervo-Cazurra, Maloney, & Manrakhan, 2007; Dau, 2013) that have boosted SME productivity/performance and innovation, however, progress has been slow, lagging behind international economies, as well as those of Central, Eastern Europe, and Asia (McDermott & Pietrobelli, 2017).

To accelerate progress in the formalisation, companies can determine precisely what kind of knowledge they need to access from international economies and how to obtain it (Giannopoulou, Yström, & Ollila, 2011). These results are in line with some authors who have argued that without formalization, inbound activities would be 'disorganised, sporadic and ineffective' (Okhuysen & Eisenhardt, 2002). Formalization reduces ambiguity by providing 'behaviour directives' (Pertusa-Ortega, Zaragoza-Sáez, & Claver-Cortés, 2010), with positive effects on the use of external knowledge (Duong et al., 2022).

Our result sustains the latest data on innovation in Ecuador published by the Ecuadorian Institute of Statistics and Census (INEC) and the World Intellectual Property Organization (WIPO), that report that Ecuadorian companies that have formal innovation processes can contribute to the economic performance

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of the country, and advocate for encouraging the way to involve working with OI networks to implement mechanisms for the management of ideas, increase knowledge and reach solutions that benefit the participants is encouraged (Correa-Quezada, Alvarez-García, De la Cruz Del Río-Rama, & Maldonado-Erazo, 2018). These results lead to relevant theoretical implications since there are few studies on how formalization shapes the OI paradigm (Gentile-Lüdecke et al., 2020). Organizations that plan systematically facilitate collaboration with external and relevant partners and improve their collaboration methods. They develop skills to use resources distinctively (Griffith, Huergo, Mairesse, & Peters, 2006), reconfigure and gain new resources, and strengthen planning for subsequent innovation projects (Zahra, Sapienza, & Davidsson, 2006). Organizations must ensure the operationalization of the strategy and its correct and timely implementation, aligning the organization and providing detailed monitoring (Brenes et al., 2008).

Regarding the effect that these OI activities have on SME innovative performance, our results are in line with Kang and Hwang (2019), who show that OI practices are important to improve innovative performance in these companies. However, this effect is moderated by control activities in the case of inbound activities. Fu, Liu, and Zhou (2019) consider that the difficulties SMEs have controlling inbound activities come from the wide range of resources involved. These difficulties lead to incomplete data about inbound collaboration, decreasing the reliability of the indicators used in control systems. Regarding outbound-type activities, we find a positive effect on the innovative performance of companies, showing the capacity that these companies have to benefit from their collaborators' and workers' knowledge, fostering an improvement in SME innovative performance, as other papers have shown (Dahlander & Gann, 2010; Masucci, Brusoni, & Cennamo, 2020). Therefore, our findings report evidence on the importance of inbound activity control to achieve a significant effect on innovative performance.

Theoretical Implications

The results of this investigation have important implications for managers and public policymakers who seek an efficient innovative ecosystem in the Ecuadorian economy. Given that OI generates greater innovative performance in Ecuadorian SMEs, activities linked to the promotion of innovation should be established through inbound and outbound OI strategies. Managers should be aware of the relevant role that innovation strategy formalization plays in promoting OI. Even though many Ecuadorian SMEs face daily operational problems, this research highlights the need to dedicate time and resources to establishing innovation strategies for the promotion of OI activities in those companies that seek a competitive advantage through innovation. In addition, managers should understand that control systems must be established for these activities, especially for

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inbound innovation, to ensure a significant effect on innovative performance. Therefore, Ecuadorian SMEs are advised to manage the transition from a traditional innovation model to an open one based on the specific planning and control of inbound activities.

In the interest of promoting innovation in the Ecuadorian context, the following issues should be addressed: regulatory changes, laws that do not facilitate innovation, bureaucracy, limited size of the market, lack of access to technology, lack of collaboration with universities, lack of tolerance to failure, short-term thinking which expects immediate rewards from innovation, and the scarce resources available to innovate. In addition, encourage governmental public entities to support knowledge diffusion as they are necessary to cultivate radical innovation (Sánchez, Rojas-Ávila, & Giraldo-González, 2021). In both cases, innovation allows exploiting actors' knowledge resources and is associated with prior concerted efforts to build capacities to drive OI (Weber & Heidenreich, 2017).

Ecuadorian public administrations should consider the results of this work when designing their innovation policies. Public administrations should foster an ecosystem that supports OI in SMEs, helping to establish orderly and planned OI models within SME strategies, implementing communication programs to socialize innovation, providing training programs in matters of innovation management, and controlling inbound and outbound activities in Ecuadorian SMEs to promote the transformation of the Ecuadorian productive matrix. Ecuadorian industries should depend less on nonrenewable natural resources and more on products with added value and highly innovative content. High-impact policy actions are required within the framework of an industrial policy for the SME sector with an emphasis on institutional development and regional collaboration, specially oriented to the development of an innovative market for Latin America. In this context, Ecuador, along with consolidating the efforts made so far, should bet on a renewed institutional framework that contributes to adjusting development policy in key areas and in those aimed at promoting business innovation, private investment, and coordination between companies and institutional actors in a perspective of productive linkages (Carpio, Figueroa, & Alvarado, 2015). Ecuadorian managers should seek the support of public administrations, together with chambers of commerce and business associations, to obtain the funding required to implement the OI activities SMEs need.

Limitations and Future Research Directions

This work is not free from limitations which, in turn, present opportunities for new lines of research. Thus, it is noteworthy that the study is limited to the Ecuadorian context. To extend these results to developing economies, it would be interesting to analyze the context of OI and control in the economies of Latin American countries, such as Colombia, Peru, Brazil, Argentina, and Chile, to corroborate the

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results obtained. The study has been based on cross-sectional data. A time-series or panel data study in future research would allow us to analyze how SMEs evolve in terms of OI activities and their efficiency. Given the importance that communication has in companies and among companies in the development of OI, in future research, it would be interesting to analyze how different means of communication within companies and among companies affect OI activities.

New research could also focus on how gaps in market support institutions underpin the functioning of developing country economies, influencing the costs of doing business, complicating the conduct of IO activities (Khanna & Palepu, 2010), and hindering the formalization of innovation strategy. These institutional gaps include uncertainty in regulatory frameworks, inefficient enforcement mechanisms, poorly functioning factor markets, excessive bureaucracy, and lack of protection of human rights and property rights (Brenes, Ciravegna, & Pichardo, 2017), and the absence of control mechanisms. For example, emerging markets often lack certain institutions that allow for more efficient trade. The absence or malfunctioning of these institutions is referred to as institutional gaps (Khanna & Palepu, 2010).

Finally, OI is closely related to the learning capacity of the firm. This capacity has been highlighted in SMEs by Perez-Aleman (2011) to understand the diffusion of new norms and change existing local practices using the collective capacity building considering the multinational's effect. Similarly, the effect of multinationals on the learning process of SMEs through collective learning is relevant when analyzing the factors within the control systems and the formalization of the strategy that reinforce collective learning and, therefore, the OI capabilities of SMEs.

NOTES

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DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

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