Innovation drivers for export performance

By: Luis Camilo Ortigueira-Sánchez, Dianne H.B. Welsh, William C. Stein

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Abstract:

According to the research-based view of the firm, innovation is a key capability that can foster a sustainable competitive advantage and explain firm heterogeneity in export performance. However, few studies have focused on the effect of innovation on export performance in the context of low levels of innovation, which developing markets are characterized by. Since exports are considered the first market entry mode, it is critical to understand the effect of innovation on exports. In this paper, we test the effect of innovation on export performance in small and medium-sized enterprises (SMEs) in Peru that have received government innovation subsidies, with a theoretical model that incorporates innovation inputs, innovation types, and performance. We test the model using partial least squares structural equation modeling from 237 SMEs. The findings show that government innovation subsidies, human capital, and cooperation have a positive effect on innovation types. Likewise, innovation types positively affect production and export performance. Production performance mediates the relationship between innovation types and export performance. This research article advances the study of innovation and export performance in an emerging market context, which are characterized by a weak innovation system and low investments on innovation. Likewise, it holds policy implications for both science, technology and innovation policy and foreign trade policy.

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Innovation drivers for export performance

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A B S T R A C T

According to the research-based view of the firm, innovation is a key capability that can foster a sustainable competitive advantage and explain firm heterogeneity in export performance. However, few studies have focused on the effect of innovation on export performance in the context of low levels of innovation, which developing markets are characterized by. Since exports are considered the first market entry mode, it is critical to understand the effect of innovation on exports. In this paper, we test the effect of innovation on export performance in small and medium-sized enterprises (SMEs) in Peru that have received government innovation subsidies, with a theoretical model that incorporates innovation inputs, innovation types, and performance. We test the model using partial least squares structural equation modeling from 237 SMEs. The findings show that government innovation subsidies, human capital, and cooperation have a positive effect on innovation types. Likewise, innovation types positively affect production and export performance. Production performance mediates the relationship between innovation types and export performance. This research article advances the study of innovation and export performance in an emerging market context, which are characterized by a weak innovation system and low investments on innovation. Likewise, it holds policy implications for both science, technology and innovation policy and foreign trade policy.

Introduction

Innovation is a source of value creation for firms and plays a key role in national competitiveness and productivity. Both Organization for Economic Co-operation and Development (OECD) and non-OECD economies are investing heavily in innovation, especially for small and medium-sized enterprises (SMEs). Innovation creates firm value through the introduction of new technologies and the exploitation of new markets. A generally accepted definition of innovation is provided by the fourth edition of the Oslo Manual, defined as " An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)” (OECD, 2018, p.20). Innovations can be characterized in four types: product, process, marketing and organizational innovation.

According to the resource-based view (RBV) of the firm (Penrose, 1959), certain internal firm resources and capabilities can be a source of sustainable competitive advantage. Specifically, internal resources that are valuable, rare, inimitable, and capable of being exploited by the organization constitute a sustainable competitive advantage (Barney, 1991). Because innovation creates value for firms, it represents a capability that is critical to firm performance. Furthermore, to a certain degree, innovation helps explain performance heterogeneity among firms, given their unique capabilities, including knowledge, skills, and experience.

Extensive studies have explored internal and external determinants of export performance, defined as "the extent to which a firm's objectives, both economic and strategic with respect to exporting a product into a foreign market, are achieved through planning and execution of export marketing strategy" (Cavusgil & Zhou, 1994, p. 4). Research on export activity continues to be relevant, as exports are the first step in the internationalization process (Johanson & Vahlne, 1977). Innovation creates a competitive advantage in global markets by allowing firms to benefit from economies of scale and overcome domestic market size constraints (Silva et al., 2017). The relationship between innovation and export performance is well established (Pla-Barber & Alegre, 2007; Rodil et al., 2016). However, this relationship still needs further exploration, as export patterns differ between SMEs in different regions, which could affect the relationship between innovation and exports (Love et al., 2016). Likewise, the understanding of this relationship in the case of developing

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markets still requires further research, as firms in these countries present resource constraints both to innovation and exporting (Wadho & Chaudhry, 2018).

Studies have found that SMEs are more efficient innovators than large firms, despite structural differences in resources and capabilities (Castillo et al., 2022; Hwang et al., 2015). Likewise, research has found that SMEs undergo rapid internationalization processes to overcome the liability of foreignness (Zahra & George, 2002). Given that exporters are more productive than non-exporters (Wagner, 2012), internationalization and innovation can be viable means to boost SME growth.

Research on the export performance of SMEs in emerging economies is scarce (Edeh et al.,2021; Oura et al., 2016). Emerging economy firms follow patterns of internationalization that differ from traditional international expansion models that were created in a developed economy context (Cuervo-Cazurra & Genc, 2008). Firms in developing countries tend to have greater resource constraints, fewer innovation activities, and fewer patent registrations than their developed country counterparts. This is highlighted by Crespi & Zuniga (2012), who find evidence that Latin American firm innovation is based largely on acquisition of capital goods and incremental innovation. Likewise, in general, Latin American firms tend to have a lower level of innovation activities and informal organizational structures to conduct innovation (Ortigueira-Sánchez et al., 2020). Moreover, the study of innovation and its impact on performance is limited in the emerging economy context (Wadho & Chaudhry, 2018); most research is centered on developed economies (Cieslik et al., 2015). In addition, most studies on Latin America have focused solely on the relationship among research and development (R&D), innovation performance, and economic performance (Heredia et al., 2018). Lastly, the study on innovation in emerging economies has tended to focus on solely on technological innovation (product and process), without considering non-technological innovation (organizational and marketing) (Geldes et al, 2016). Given these research gaps in emerging economy context, there is a need to further develop the literature on innovation.

In the past 20 years, Latin American governments have increased their public spending on innovation, with the aim to improve national productivity and competitiveness. For example, public R&D spending as a percentage of gross domestic product, has increased in Peru, from 0.06% in 2012 to 0.12% in 2016 (RICYT, 2018). Government funding of firm R&D and innovation activities is important for policy makers, as it contributes directly to national competitiveness and economic development (Basit et al., 2018). However, the debate is ongoing in the literature about the effectiveness of subsidies on export performance. Some studies find that the effect is dependent on the innovation subsidy amount, initial status of the firm, experience as an exporter, and the time span of analysis (Liu et al., 2019; Gustafsson et al., 2016). Along with identifying the impact of innovation and export performance, our study builds a theoretical model of how subsidies affect SME innovation, and how this ultimately impacts export performance. As innovation improves performance (Zahra & George, 2002), implementing subsidy analysis in our model, as an input of innovation, gives a more comprehensive understanding of its role.

Considering that SMEs represent roughly 99% of firms in Peru, account for 71.50% of exporting firms, and represent 86% of formal employment in the private sector (*Ministerio de la Producción* – Ministry of Production of Peru, 2017), the subject merits research in Peru. Likewise, SMEs represent 86% of formal employment in the private sector However, SMEs only represent 3.80% of the total export value. Most exports come from the agricultural, mining, and textile industries in which SMEs do not operate (*Consejo Nacional de Competitividad y Formalización*- Peruvian National Council of Competitiveness and Formalization, 2019). Furthermore, emerging market SMEs struggle to consolidate their position in international markets, as 87% of exporting companies in Peru are sporadic, affecting export performance directly (Malca-Guaylupo & Rubio, 2013).

Thus, the understanding of the relationship between innovation and export performance in the case of developing country SMEs is limited. Moreover, the effect of innovation subsidies on export performance needs further study. Thus, the purpose of this research is to test the effect of innovation on export performance of SMEs. Likewise, our research analyzes the impact that public subsidies have on innovation activities in SMEs. Do SMEs have superior export performance due to innovation? Likewise, does public subsidies improve innovation activities in SMEs? Both research questions proposed hold practical implications for policymakers in the economic development and foreign trade policy fields.

This study builds upon research of innovation in Latin America, contributing to the analysis of both technological and non-technological innovation's impact on performance (Geldes et al., 2016; Heredia et al., 2018). Likewise, it reinforces Azar & Ciabuschi's (2017) observations of a non-linear effect between innovation and export performance. In terms of practical implications, our results indicate that SMEs develop the domestic market first, before transitioning into international markets. This could be explained by a lack of managerial capabilities and resources, which the SME needs to build in order to begin exporting.

Theoretical framework

The resource-based view

Past studies on the effect of innovation on performance generally apply two theoretical fields. On the one hand, there is the industrial organizational theory, which states that structural characteristics and industry dynamics affect the behavior and performance of firms within a specific industry, as well the industry's technological development (Acs & Audretsch, 1987). In contrast, recent studies, in line with the RBV, have shifted to focus on the firm-specific effects on performance (Hawawini et al., 2003). The main difference between the two approaches is in explaining business performance; while industrial organization theory applies industrial structure and dynamics to explain differences in performance, the RBV focuses on the heterogeneity of firm resources (Guan & Pang, 2017). Given the empirical nature of the paper, and the objective of analyzing the effect on firm performance due to resources heterogeneity, the present study adopts the RBV, in line with the recent literature on innovation (Bicakcioglu et al., 2019; Haddoud et al., 2021; Edeh et al., 2020)

The RBV stems from the seminal work of Penrose (1959), who lays the foundations for the theory of the firm. This theory conceptualizes the firm as a bundle of resources which are distributed heterogeneously between firms, and these differences persist over time (Eisenhardt & Martin, 2000). Likewise, it states that firms are heterogenous from each other, given the heterogeneity in resource endowment.

This theory focuses on the idea that certain internal resources can be a source of sustainable competitive advantage. Specifically, those internal resources which are valuable, rare, inimitable and capable of being exploited by the organization - the VRIO framework - constitute a sustainable competitive advantage (Barney, 1991). Originally, the RBV has focused exclusively on internal resources; however, it has expanded to include of both internal and external resources that constitute a sustained competitive advantage (Yao et al., 2015).

The Dynamic Capabilities (DC) approach has given the RBV a more dynamic perspectives of resources; it states that resources are dynamic, in the sense that they can be integrated, reconfigured, and recombined in order to create value-generating strategies (Eisenhardt & Martin, 2000; Grant, 1996). Likewise, it distinguishes resources, which are viewed as tangible or intangible assets, from capabilities, which are the firm's capacity to deploy those resources

(Silva et al., 2017); thereby, a capability is organizationally embedded, firm-specific, and non-transferable (Makadok, 2001).

DC were coined by Teece et al.. (1997) who define them as “the firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments” (Teece et al., 1997, p. 516). Thus, the RBV affirms that firm resources, internal and external, tangible and intangible, are the base for sustained competitive advantages and value creating strategies. The RBV, along with the DC approach is relevant in this article for three reasons.

First, innovation capabilities at the organizational level constitutes a DC that can be a source of sustainable competitive advantage, especially in international markets (Oura et al., 2016; Pla-Barber & Alegre, 2007). Innovation requires that organizations exploit their assets and draw upon capabilities, transforming these into performance outcomes (Silva et al., 2017).

Second, the RBV is an accepted and widely used theoretical field in the international business literature, especially in the context of internationalization and export performance. External resources such as networks, can be leveraged in order to overcome liability of foreignness in international markets (Johanson & Vahlne, 1977); likewise, home-market resources can constitute a competitive advantage in regard to foreign-market resources.

Third, the RBV has become a widely used theoretical field in order to understand strategies in emerging markets (Hoskisson et al., 2000; Wright et al., 2005; Xu & Meyer, 2013). Firms in emerging markets differ from those in developed markets, and may face resource scarcity; likewise, resources that constitute competitive advantages differ under distinct institutional contexts. Knowledge-based and relational capabilities are specially relevant in these contexts (Hoskisson et al., 2000).

Innovation

The concept of innovation was pioneered by Schumpeter (1934), who described the role of technological innovation as fundamental to economic growth and competitiveness. Since this initial conceptualization, innovation studies have flourished. However, Schumpeterian theory hypothesized that larger and older enterprises outperform SMEs regarding innovation capacities, due to the fact that innovation requires high market power, and the high entry barriers to innovate dissuade SMEs from doing so. Nevertheless, contemporary studies have found that SMEs are superior to large firms in innovation activity, and are more efficient innovators (Cohen & Klepper, 1996), despite inherent limitations such as lack of resources, human capital, management structure, underdeveloped capabilities and infrastructure (Edeh et al., 2020). This is because tacit knowledge is easier to transform into explicit knowledge in SMEs, given their organizational structure (Castillo et al., 2022).

Furthermore, in the international business literature, SMEs have been found to conduct rapid internationalization processes, overcoming resource constraints and liability of foreignness and newness (Zahra & George, 2002). Thus, SMEs have been found capable of managing complexity, both in innovation activities and in internationalization, despite structural limitations (D'Angelo, 2012). Given this phenomenon on innovative activities in SMEs, and the fact that literature on SMEs in emerging markets is scare, this study’s focus is emerging market SMEs.

In regard to innovation, it has been defined as: “a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)” (OECD, 2018, p.20). The innovation process involves the transformations of ideas into new products, processes, organizational structures and managerial processes (Damanpour & Evan, 1984). The Oslo Manual of the OECD classifies innovation into four categories: product innovation, process innovation, marketing innovation and organizational innovation (OECD, 2018). Regarding the first two, product innovation gives firms a competitive edge by introducing new or improved goods or services, increasing client demand; while process innovation is intended to reduce production costs and increase productivity through changes in techniques or technology (Hwang et al., 2015).

A further classification of innovation divides innovation types into two categories: technological innovation and non-technological innovation. Product and process innovation is associated to the first, while organizational structures and managerial processes, to the latter. Technological innovation is defined as “the implementation of an idea for a new product or new service or the introduction of new elements in an organization’s production process or service operation” (Damanpour & Evan, 1984, p. 394). On the other hand, non-technological innovation is referred to as “new approaches in knowledge for performing the work of management and new processes that produce changes in the organizations strategy, structure, administrative procedures and systems” (Damanpour & Aravind, 2011, p. 429).

Research on the impact of innovation on export performance has found a positive effect (Heredia et al., 2018; Pla-Barber & Alegre, 2007; Silva et al., 2017). However, the debate is still ongoing. For example, Perez et al (2012) find that exporters are more innovative than non-exporters, while Wakelin (1998) finds that non-innovative firms are more likely to export than innovative firms of similar size. Moreover, knowledge is limited in the case of SMEs from developing countries (Oura et al., 2016). The different results obtained can be explained in part by the lack of consensus on the measurement of innovation. For example, studies tend to focus on only one type of innovation or solely technological innovation, without taking into consideration non-technological innovation (Basit et al., 2018; Gunday et al., 2011; Kolade et al, 2019). Thus, a further clarification of this merits research, including an integral model to understand the innovation process in SMEs from developing countries.

Hypothesis formulation

Fig. 1 depicts our proposed theoretical model. Given the time-consuming and capital-intensive nature of innovation activities (Harrison et al., 2001), government innovation agencies, through innovation subsidies, act as an external resource to foster firm innovation, overcome technological risks, and encourage technology spillover (Wei & Liu, 2015). Several studies have identified a positive relationship between government innovation subsidies and innovation. For example, government-subsidized firms grow more rapidly than other firms, access finance more successfully, and further invest in innovation activities (Audretsch et al., 2002; Lerner, 2002). While some scholars argue that there is a crowding-out effect of subsidies with regard to firm expenditure, Hall et al. (2009) showed that subsidy-recipient firms boost their innovation activities.

Wei & Liu (2015) found a positive relationship between government innovation subsidies and innovation types in Chinese firms. Confirming those results, both Zhu et al. (2018) and Liu et al. (2018) found a positive relationship between government subsidies and technological innovation. In a comparative group analysis, Guo et al. (2016) showed that government-subsidized firms generate more innovation outputs than non-subsidized firms. This finding is valid for both technological (Le & Jaffe, 2016; Yao et al., 2015) and non-technological (Basit et al., 2018) innovation. Thus, we hypothesize the following:

H1. Government innovation subsidies are positively related to innovation types, including (a) product innovation, (b) process innovation, (c) organizational innovation, and (d) marketing innovation.

In terms of antecedents to firm innovation output and performance, research has examined both internal and external inputs. Regarding internal inputs, human capital related to innovation is a key resource that stimulates innovation output and is a critical

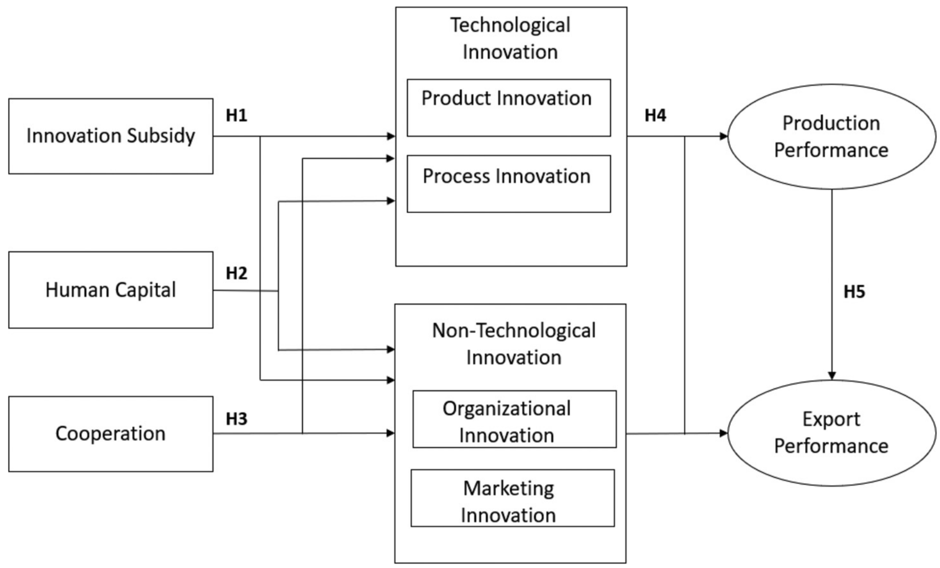

Fig. 1. Proposed theoretical model of export performance.

antecedent to the generation of innovation activities (Wadho & Chaudhry, 2018). Human capital is also important because innovation talent—a valuable, rare, inimitable, and capable-of-being-exploited resource—constitutes a sustainable competitive advantage for the firm (Barney, 1991). Moreover, human capital productivity has a positive impact on exporting (Arnold & Hussinger, 2005; Eliasson et al., 2012), especially for SMEs (Falk & de Lemos, 2019), as do the types of innovation (Crepon et al., 1998) and export intensity (Lopez & Garcia, 2005). Likewise, R&D personnel exert a positive impact on innovation performance (Zhu et al., 2018) and increase export intensity (D'Angelo, 2012).

In terms of developing countries, in their study of Pakistani manufacturers, Wadho and Chaudhry (2018) found that labor productivity leads to innovation outputs Santos et al. (2014). showed that human capital significantly affects innovation performance in Brazilian firms, while Heredia et al. (2018) found that human capital positively influences product innovation in Chile. Similarly, Valle (2018) identified that human capital positively influences product innovation and had an indirect effect over export performance. Lastly, Ortigueira-Sanchez et al. (2020) found that training activities conducted in SMEs positively impacts innovation. Thus, we hypothesize the following:

H2. Human capital is positively related to (a) product innovation, (b) process innovation, (c) organizational innovation, and (d) marketing innovation.

Given that innovation can be a non-linear learning process, successful innovation requires that firms exploit and use external knowledge. Likewise, innovation is both a social and technical process, which can be improved through organizational networks and linkages (Kolade et al, 2019). Generation of this knowledge will depend on the frequency and density of the firms' interactions with external sources (i.e., suppliers, customers, competitors, universities, financial institutions, and industry associations) (Van Hemert et al., 2013). By cooperating with external sources, firms can acquire knowledge and increase their absorptive capacity (Cohen & Levinthal, 1989). Furthermore, cooperation acts as a mechanism for SMEs to share costs and reduce the risks associated with innovation and to improve outcomes (Morales & Sifontes, 2014). For SMEs, cooperation with international actors increases their exposure to external knowledge resources, which promotes innovation and consequently, export performance (Ardito et al., 2019; Edeh et al., 2020).

Several studies have identified cooperation with external actors as critical to innovation performance. This includes cooperation with universities to increase export performance and intensity (D'Angelo, 2012), cooperation between universities and research institutes to drive innovation in SMEs (Van Hemert et al., 2013), and cooperation between suppliers and customers to increase innovation (Wadho & Chaudhry, 2018). In Latin America, Morales & Sifontes (2014) found that cooperation increases technological innovation by enabling the exchange of skills. In addition, Heredia et al. (2018) found that cooperation has a positive effect on product, process, and organizational innovation in Peru, but they found no effect of cooperation on innovation types in Chile. Thus, we hypothesize the following:

H3. Cooperation is positively related to (a) product innovation, (b) process innovation, (c) organizational innovation, and (d) marketing innovation.

To compete and gain a competitive edge, both technological and non-technological innovations are required (Damanpour & Evan, 1984). Thus, innovation is positively related to firm performance, on dimensions that include production, financial, market, and export performance (Gunday et al., 2011; Pla-Barber & Alegre, 2007). This relationship holds for both technological and non-technological innovation (Silva et al., 2017; Yao et al., 2015). In line with the RBV, innovation outcomes are the product of organizations drawing on their resources and capabilities to transform these outcomes into firm performance, and thus they have a direct impact on performance.

A dimension that has received particular attention in the literature is the impact of innovation types on export performance, especially in international firms. Several empirical studies have found that innovation types are positively related to export performance Pla-Barber & Alegre (2007). found a significant and positive relationship between innovation and export performance in science-based French firms D'Angelo (2012). analyzed innovation and export intensity in Italian SMEs and reported similar results. Research has also found that both technological and non-technological innovation have a significant impact on export performance (Azar & Ciabuschi, 2017; Rodil et al., 2016; Silva et al., 2017).

While in general terms this relationship has been confirmed, it is contingent on several factors. For example, in their study on Chinese firms, Cieslik et al. (2015) found that this relationship was dependent on firm size. Likewise, in a study on Korean firms, Hwang et al. (2015) showed that the effect on export performance is related to time span—the effect is maintained over longer time spans for large enterprises but shorter time spans for SMEs. In their meta-analytic review of the literature on innovation and export performance, Bicakcioglu et al. (2019) find that this relationship is hindered by the level of development of the host country, thereby differences may be found in emerging economies.

Nonetheless, recent findings in emerging economies and within SMEs are consistent in the literature. For example, Geldes et al. (2017) found a positive effect of the relationship between technological and non-technological innovation on firm performance in Chile, a finding that has also been found by Murat & Baki (2011) in the case of Turkish firms and Dai & Liu (2018) in Chinese firms. Moreover, Oura et al. (2016) found that capacity had a significant relationship to export performance for Brazilian SMEs. Last, Heredia et al. (2018) confirmed the relationship between innovation types and performance for both Chile and Peru but found an additional relationship to export performance in the case of Peru. Thus, we hypothesize the following:

H4. Innovation is positively related to (a) production performance and (b) export performance.

Firms innovate to maintain a competitive advantage among competitors, such as the first-mover advantage in markets or the elimination of performance gaps (Damanpour & Evan, 1984). Innovation enables enterprises to reconfigure firm resources and capabilities, and thus respond to changes in the environment (Gunday et al., 2011). In addition, innovation results, such as increased productivity and development of new goods or services, enhance a firm's export status (Dai & Liu, 2018). Therefore, while there is a clear link between innovation and export performance, it is contingent on production performance. For example, Azar & Ciabuschi (2017) reported that technological innovation radicalness and extensiveness mediated the effect of non-technological innovation on export performance, indicating a non-linear effect between the two constructs. Likewise, Silva et al. (2017) found that competitive intensity, export resources, and market-oriented capabilities mediate the effect of technological and non-technological innovation on export performance.

Exporters tend to engage more in innovation than non-exporters (Wadho & Chaudhry, 2018). This is because more productive firms self-select into exporting, and participation in international markets fosters technology improvements (Fassio, 2017). This premise implies that firms achieve both successful production and market performance before self-selecting into exporting and gaining superior performance. In other words, firms must be more productive and market-oriented to self-select into exporting. In turn, this becomes a dynamic virtuous circle, in which innovation and export performance mutually reinforce each other (Golovko & Valentini, 2011; Muñoz et al., 2022).

Moreover, Oura et al. (2016) found that international experience has a greater impact on export performance than innovation capacity itself in a study on Brazilian SMEs. Their measure of innovation capacity included testing marketing and production capacity on export performance. Mirroring these findings in a study of Chinese firms, Guan & Ma (2003) found that export performance rates improve significantly with production, marketing, and R&D capabilities. Finally, in a study of Turkish manufacturing firms, Karabulut (2015) found that innovation outcomes improve both production and marketing performance, which in turn mediate the effect of innovation on financial performance, measured by both local sales and exports, with innovative firms having higher exports. Overall, Bicakcioglu et al. (2019) identify a moderating effect between innovation and export performance, based on a lag effect, as innovations will firstly produce greater efficiencies within the firm before entering or exploiting foreign markets. Thus, we predict the following:

H5. Production performance mediates the relationship between innovation types and export performance.

Methodology

Sample

We collected 237 surveys completed by top managers of SMEs from Innovate Peru, the national innovation agency of the government. Innovate Peru issues a compulsory online questionnaire to SMEs that apply for public funds to finance an innovation project. The survey is based on the Oslo Manual (OECD, 2018), with adaptations from the Bogota Manual (Jaramillo et al., 2001), to allow for structural differences in innovation in developing countries. For example, Latin American firms face a weak institutional R&D ecosystem, informal organizational structures for realizing innovation activities, and a low degree of cooperation among firms; in addition, most innovation activities involve the acquisition of technology, among other factors (Jaramillo et al., 2001).

Most of the firms in the sample (41%) are SMEs in the primary and extractive industries. Economic activities in primary industries include agriculture, fisheries, and aquaculture, and extractive activities include mining, gas, and energy. Manufacturing firms constitute slightly more than one-third of the sample and are in industries ranging from food and beverages, to textiles and apparel, to the manufacturing of equipment and machinery. The services industry consists of a broad range of activities, including architecture and engineering services, health services, financial services, and information technologies.

In terms of size, the Peruvian survey is based on legislation that incorporates two sub-categories: producer associations and microenterprises. A producer association comprises individual producers categorized into a common organization that sells goods to the market and distributes the earnings. A microenterprise is defined as having income of less than S/. 630,000 (≈US$190,910). In terms of comparability, both producer associations and microenterprises can be considered small firms. Table 1 reports the sample characteristics.

With regard to geographic location, Peru's economic activities are heavily concentrated in Lima, where there are more manufacturing- and service-based industries. The other regions tend to have more primary and extractive industries. In the sample, roughly half of the firms are in Lima, and the other half are in the other regions of Peru. We tested for unobserved heterogeneity in the sample by using the SmartPLS 3 inbuilt method of finite mixture PLS method (FIMIX-PLS). As the information criteria were unable to pinpoint to the same number of segments (Latan & Noonan, 2017; Sarstedt et al., 2017), we conclude that there is no unobserved heterogeneity in the sample. Table 2 provides descriptive statistics.

The average innovation subsidy is approximately US$71,000, though the standard deviation is roughly US$34,000, depending on firm size and heterogeneity. In terms of professional staff, the average number is about seven employees, with a large variance. The professional staff of the SME sample is small. This could be due to the firm

Table 1
SME characteristics of the sample.

Characteristic	% of total SMEs
Economic sector	
Primary and extractive industries	41.35%
Manufacturing	32.49%
Services	26.16%
Size	
Producer association	8.86%
Microenterprise	47.68%
Small enterprise	30.38%
Medium-sized enterprise	13.08%
Geographic location	
Lima	53.16%
Rest of Peru	46.84%

Table 2
Descriptive statistics.

Innovation subsidy (S/. and US$)	
Mean	S/. 235,450 (US$71,348)
SD	S/. 113,043 (US$34,256)*
Professional human capital (number of employees)	
Mean	7.40
SD	11.92
Cooperation (% of total sample)	
Cooperation with technology and knowledge institutes	62.45%
Cooperation with suppliers and consultants	73.00%
Cooperation with other firms and institutes	61.18%
Technological innovation (% of total sample)	
Product	67.09%
Process	58.65%
Non-technological innovation (% of total sample)	
Organizational	29.96%
Marketing	23.21%

*Based on the exchange rate of soles to dollars: 3.30.

size itself and also because a large proportion of the sample contains microenterprises, which tend to have fewer than 10 employees.

Regarding R&D, a high proportion of firms reported cooperating with industry players, such as consultants, experts, and suppliers. Financial institutions and foreign headquarters reported low cooperation. Most SMEs reported cooperating with universities and laboratories, but less so with research institutes and technical training institutes in the area of knowledge generation. Technological innovation predominates. Product innovation is reported most often, followed by process innovation and, to a lesser extent, organizational and marketing innovation. More than half the total sample reported technological innovations, while less than one-third reported non-technological innovations.

Table 3 provides a list of the variables used in the study. We used three control variables to test for moderation effects. First, we controlled for firm size and categorized the firms as micro, small, or medium-sized. According to Peruvian legislation, a firm is considered a microenterprise if its annual income (total sales) does not exceed S/. 630,000 (US$190,910), a small firm if its annual income is between S/. 630,001 (US$190,911) and S/. 7,140,000 (US$2,163,636), and a medium-sized firm if its annual income falls between S/. 7,140,001 (US$2,163,637) and S/. 9,660,000 (US$2,927,272). Second, we controlled for the type of innovation project and used the classifications of primary and extractive industries, manufacturing, and services. Third, we controlled for geographic location, given the heterogeneity of firms in Lima compared with that of firms in the other regions.

All constructs used in the model, not taking into account single indicator constructs, are of reflective nature (also known as common factor) due to the indicators being a manifestation of the latent variables they belong to (Henseler, 2017).

Method

We employed structural equation modeling (SEM), using the variance-based partial least squares estimation procedure (PLS), which is a second-generation multivariate data analysis method. The statistical software used in SmartPLS 3.0. (Ringle et al., 2015) SEM is in line with previous studies on both innovation and export performance (Azar & Ciabuschi, 2017; Gunday et al., 2011; Heredia et al., 2018; Oura et al., 2016; Pla-Barber & Alegre, 2007; Silva et al., 2017; Stoain et al., 2011). Likewise, it has become an accepted approach as a covariance-based technique for estimating cause−effect relationship models in the literature (Hair et al., 2012). and PLS-SEM is considered an appropriate tool in the case of highly complex relationships in theoretical models (Chin et al., 2003).

Use of PLS-SEM in our study is both relevant and pertinent for several reasons. First, because the relationships we propose have not been fully validated in the Latin American context, we want to add to the theory on innovation and export performance in the region. Second, to our knowledge, there are no direct measures of overall performance in the production and export sectors, thus requiring the use of latent variables, which can be studied the PLS-SEM. Third, given the hypotheses formulated, the high number of variables, and the complexity of the conceptual model, PLS-SEM is an appropriate method as it eases the interpretation of the model and the relationships between constructs.

PLS-SEM modeling is undertaken through path models, which include two types of variables: observable and latent. In Fig. 1, the variables in rectangles are observable variables, while those in circles are latent variables. Likewise, the latent variables are classified into two types: exogenous and endogenous. In the case of our research model, export performance is the endogenous latent variable. In the theoretical model, all the latent variables are reflective, or common factor, models.

With regard to the statistical tests' performance, because the data was not distributed normally, the tests used are all non-parametric statistics. We assess the convergent validity of the model on the basis of average variances extracted (AVEs) (Fornell & Larcker, 1981, Hair et al., 2017). AVEs are acceptable if greater than 0.5 (Hair et al., 2017). Composite reliability (CR) and Cronbach's alpha coefficient test for internal consistency and reliability; these coefficients are acceptable if greater than 0.7 (Azar & Ciabuschi, 2017; Pla-Barber & Alegre, 2007, Hair et al., 2017). Likewise, we calculate outer loadings for the observable variables and their constructs, where a coefficient greater than 0.70 is acceptable (Cohen, 1992, Hair et al., 2017).

To test for discriminant validity, we used the heterotrait-monotrait (HTMT) as it is considered a more reliable method compared to the Fornell-Larcker criterion and the use of cross loadings, due both methods present limitations. (Hair et al., 2017). The HTMT is used to analyze the would-be correlations between latent constructs. (Hair et al., 2017). Ideally, the HTMT values should be below the threshold of 0.85 (Hair et al., 2017) as to prove that the constructs are unique and not redundant with each other.

To test the structural model, we used the R-square coefficient, which reflects the variance of the endogenous variable explained by the structural model (Oura et al., 2016), thus providing an assessment of the statistical power. The R-square coefficient should be 10% at a minimum (Falk & Miller, 1992).

Next, we ran the structural model in SmartPLS 3.0. In this case, we used the path coefficients to analyze the nature of the relationships proposed. Likewise, the t-test statistics, along with the significance level, helped determine whether the hypotheses proposed are supported. We tested significance levels at the 0.10, 0.05, and 0.01 levels.

In order to study the possible necessary conditions of the model, a necessary condition analysis (NCA) was carried out. To perform the analysis, we followed the guidelines proposed by Richter et al. (2020) by using PLS-SEM (with SmartPLS 3.0) together with NCA (implemented with the statistical software *R*). A very brief summary of the process is as follows.

First, we obtained the latent variable scores of the structural equation model by running a PLS-SEM analysis in SmartPLS 3.0, which were then imported, in a CSV file, to the statistical software *R*. Since all the constructs in our model were reflective, no additional data was required for the NCA analysis. After the data was imported into *R* we executed the code found in the Appendix of Richter et al. (2020) to carry out the NCA. Since our model only has one endogenous construct (*Export Performance)* only one NCA was performed. Subsequently, after the results showed two possible necessary conditions (*Innovation Subsidy* & *Production Performance*), a significance test was implemented for each by following the code presented in Richter et al. (2020).

Table 3
Summary of variables and constructs.

Category	Sub-category	Item description	Variables and scale	References
Innovation subsidy	Government monetary subsidy	Amount of economic resources given to the SME by the government in the form of direct subsidy for innovation	Numerical	(Basit et al., 2018) (Yao, et al., 2015) (Zhu et al., 2018)
Human capital	Human capital	SME professional staff	Numerical	(Falk & de Lemos, 2019) (Heredia et al., 2018) (Zhu et al., 2018)
		SME employee staff	Numerical	
		SME laborer staff	Numerical	
Cooperation	Technology and knowledge institutes	Relationships with universities, research institutes, technical training institutes, and/or laboratories for R&D activities	Dichotomous	(Heredia et al., 2018) (Van Hemert et al., 2013) (Wadho & Chaudhry, 2018)
	Headquarters and funders	Relationships with foreign headquarters and/or financial institutions for R&D activities	Dichotomous	
	Suppliers and consultants	Relationships with suppliers and/or consultants for R&D activities	Dichotomous	
	Other firms and institutes	Relationships with other firms and institutes for R&D activities	Dichotomous	
Technological innovation	Product innovation	New or significantly improved goods or services	Dichotomous	(Cieslik et al., 2015) (D'Angelo, 2012) (Heredia et al., 2018) (Wadho & Chaudhry, 2018)
	Process innovation	New or significantly improved processes	Dichotomous	
Non-technological innovation	Organizational innovation	New business practices, internal or external work organization methods	Dichotomous	(Cieslik et al., 2015) (D'Angelo, 2012) (Heredia et al., 2018) (Wadho & Chaudhry, 2018)
	Marketing innovation	Changes in product design or packaging, new marketing methods in price, distribution, or promotion	Dichotomous	
Performance	Production Performance	Degree of importance of improving product quality	Ordinal (1-4)	(Basit, Kuhn, & Ahmed, 2018; Cieslik, Michalek, Michalek, & Mycielski, 2015; D'Angelo, 2012; Fassio, 2017; Gunday, Ulusoy, Kilic, & Alpkan, 2011; Heredia Perez, Geldes, Kunc, & Flores, 2018; Hwang, Hwang, & Dong, 2015; Silva, Styles, & Lages, 2017; Wadho & Chaudhry, 2018)
		Degree of importance of increasing production capacity	Ordinal (1-4)	
		Degree of importance of reducing labour costs	Ordinal (1-4)	
		Degree of importance of reducing raw material and supply consumption	Ordinal (1-4)	
		Degree of importance of reducing energy consumption	Ordinal (1-4)	
		Degree of importance of improving environment, health and/or safety aspects	Ordinal (1-4)	
	Export Performance	Degree of importance of expanding the range of products offered	Ordinal (1-4)	
		Degree of importance of maintaining market share	Ordinal (1-4)	
		Degree of importance in reaching international standards or regulations	Ordinal (1-4)	
		Degree of importance in opening new markets	Ordinal (1-4)	

Results

Assessment of measurement model

To compare the latent and observable variables, we calculated the outer loadings of the observable variables. Table 4 displays the results of the outer loadings for the observable variables related to the production, market, and export performance constructs.

As Table 4 shows, all the observable variables have a good outer loading fit, given that they are all greater than the 0.70 recommended threshold (Cohen, 1992). The lowest value is 0.706, for the production impact of reducing energy consumption. For market performance, the constructs have higher outer loadings, which is also the case for export performance. Furthermore, all the variables' p-values are statistically significant at the 0.01 level. Given the high level of significance, the observable variables fit the latent variables well, which accounts for indicator reliability. Table 5 here shows the results of the model's construct reliability and validity.

In terms of convergent validity, the AVE values for the three latent variables meet the minimum value of 0.50 or higher (Hair et al., 2017). This coefficient means that, on average, the construct explains more than half the variance of the observable variables. In this case, the AVE value of production performance is lower than both the market and export performance AVE values, as the production performance construct is dependent on six indicators while the other constructs are dependent on only two. Thus, in general, market and export performance can better explain the variance of their indicators than production performance. All values fall within an acceptable range.

To measure the model fit, we calculated the R-square values for the dependent variables. These values indicate the variance of a dependent variable that is explained by an independent variable. In general, values above 0.75 are acceptable, indicating high explained variance, while values between 0.75 and 0.50 indicate a moderate explanation; values up to 0.25 indicate a low effect and R-square (Hair et al., 2017). Table 6 reports these results.

Regarding the innovation outcome variables, organizational, market, product, and process innovation have significant p-values, but low R-square values. These low values indicate a low effect of explained variance. Nonetheless, their values are low because technological and non-technological innovation depends on independent variables that are dichotomous or numerical, such as a government subsidy or cooperation. In the case of export performance and production performance, both constructs, formed by ordinal variables, present higher significant R-square values. Production performance has a R-square value of 0.182, which indicates low explained variance. By contrast, export performance has a R-square value of 0.546, indicating a moderate explained variance.

Results of the structural equation model

Given our thorough assessment of the measurement model, indicating construct reliability, consistency, and validity, and as the

Table 4
Outer loadings of observable variables.

Latent and observable variables		Original sample (O)	Standard deviation (STDEV)	T-statistics (|O/STDEV|)	p-values
Production performance					
	Improving product quality	0.737	0.036	20.523	0.000
	Increasing production capacity	0.799	0.027	29.863	0.000
	Reducing energy consumption	0.697	0.044	15.799	0.000
	Reducing raw material and supply consumption	0.733	0.038	19.158	0.000
	Reducing labor costs	0.822	0.023	36.332	0.000
	Improving environment, health, and/or safety aspects	0.729	0.041	17.777	0.000
Export performance					
	Expanding the range of products offered	0.803	0.031	25.529	0.000
	Maintaining market share	0.855	0.023	37.997	0.000
	Reaching international standards or regulations	0.687	0.035	19.844	0.000
	Opening new markets	0.828	0.032	25.81	0.000

Table 5
Construct Reliability and Validity

Latent variable	Cronbach's alpha	CR	AVE
Production performance	0.851	0.887	0.569
Export performance	0.803	0.873	0.633

model fit measures fall within acceptable ranges, the structural equation model is valid (see Table 7). First, for government innovation subsidies, we found a positive and significant effect on product and organizational innovation, at the 0.10 level. However, the effect was non-significant for process and marketing innovation; thus, H1a and H1c are supported, but H1b and H1d are not.

Second, we found positive and significant effects of human capital on innovation types, at the 0.05 level. Having employee staff positively affects product and process innovation; having laborer staff positively affects process innovation, and having professional staff positively affects organizational innovation. However we also found that having employee staff has a negative effect on marketing innovation while having laborer staff has a negative effect on organizational innovation. Thus, H2a and H2b are supported; H2c is partially supported; and H2d is not supported.

Third, the relationship between cooperation and technology and knowledge institutes positively affects process and marketing innovation at the 0.05 level. The relationship between cooperation and suppliers and consultants positively affects both product and process innovation at the 0.01 level and organizational innovation at the 0.05 level. Finally, the relationship to other firms and institutes affects both organizational and marketing innovation at the 0.05 level. Given that cooperation affects all the innovation types, H3a, H3b, H3c, and H3d are supported.

For the effect of innovation type on performance (see Table 8), we found that product innovation positively affects both production and export performance, and process innovation positively affects production performance while affecting negatively export performance. For non-technological innovation, organizational innovation has a positive impact on export performance and marketing innovation on production performance, both at the 0.05 level. Thus H4a is supported while H4b is partially supported.

Last, regarding the mediation effect we found that production performance has a direct effect on export performance at the 0.01 level (see Table 9). We also found that production performance has a mediating effect on product, process, and marketing innovation but not for organizational innovation (see Table 10). Thus, hypothesis H5 is partially accepted.

Table 11 shows the results of the NCA analysis. The columns represent all constructs of the model, the first column being the endogenous construct of the model (*Export Performance*), while the rows represent the percentage levels. The figure suggests that in order to reach a 80% level of *Export Performance*, two necessary conditions must be fulfilled: *Innovation Subsidy* must be at least at a 3.4% level, and *Production Performance* must be at least at a 16.2% level.

Table 6
R-square values of dependent variables.

Dependent variables	Original sample (O)	Standard deviation (STDEV)	T-statistics (|O/STDEV|)	p-values
Export performance	0.51	0.051	9.991	0.000
Production performance	0.168	0.032	3.514	0.000
Product innovation	0.068	0.035	1.968	0.025
Process innovation	0.066	0.032	2.05	0.02
Marketing innovation	0.036	0.02	1.83	0.034
Organizational innovation	0.087	0.031	2.841	0.02

Table 7
Structural equation model results for innovation inputs and innovation types.

Innovation inputs		Product innovation	Process innovation	Organizational innovation	Marketing innovation
Innovation subsidy		0.080*	0.063	0.102*	-0.008
Human capital					
	Employee staff	0.066*		-0.135***	-0.093***
	Laborer staff		0.074**	-0.044*	
	Professional staff			0.107**	
Cooperation					
	Technology and knowledge institutes		0.124**		0.098**
	Suppliers and consultants	0.248***	0.186***	0.113**	
	Other firms and institutes			0.116**	0.106**

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 8
Structural equation model results for innovation types and performance.

Innovation types		Production performance	Export performance
Technological innovation			
	Product	0.272***	0.192***
	Process	0.186***	-0.082**
Non-technological innovation			
	Organizational	-0.046	0.121**
	Marketing	0.137**	0.007

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 9
Structural equation model results for production and market performance and export performance.

Performance	Export performance
Production performance	0.62***

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 12 shows the effect sizes and p-values for the possible necessary conditions found in the NCA analysis. The results suggest the *Production Performance* has a small effect ($d<0.1$) (Dul, 2016) while *Innovation Subsidy* is not a necessary condition as its effect size is not significant. Thus, we find that *Production Performance* is a sufficient condition, per the results of the PLS-SEM analysis (Table 11), and a necessary condition, as a result of the NCA.

Discussion

The purpose of this research was to test the effect of innovation on export performance for SMEs that received innovation subsidies. This research had two major objectives. The first objective was to test the relationship between innovation and export performance, whether directly or mediated by other variables, while the second objective was to test the role of national innovation agencies in the relationship between innovation and performance.

Based on the RBV, we developed a proposed theoretical model and empirically tested it. This model differs from other models in previous research in several ways. First, past models of innovation have focused solely on R&D's impact on performance (Crespi & Zuniga, 2012; Falk & de Lemos, 2019; Morales & Sifontes, 2014); while our model reflects the innovation process within a firm, by grouping multiple variables into three categories: innovation inputs, innovation types, and performance. In doing so, we theoretically follow a process by which innovation outcomes affect firm performance. Second, our model incorporates the role of innovation subsidies in the relationship between innovation and export performance, which, to our knowledge, has not been previously examined in Peru. Third, it analyzes both technological and non-technological innovation, along with the four innovation types proposed by the Oslo Manual: product, process, organizational, and marketing innovation. Past studies on innovation in emerging markets have tended to focus solely on technological innovation, without taking into consideration non-technological innovation's potential impact on performance (Basit et al., 2018; Geldes et al., 2016). Fourth, it considers both a direct and mediated relationship between innovation types and export performance, while past studies have only tended to focus on a direct effect, without considering potential moderators (Bicakcioglu et al., 2019; Heredia et al., 2018; Kostopoulos et al., 2011).

The findings reveal a positive and significant relationship between government innovation subsidy and innovation types. In particular, innovation subsidy has a positive effect on SME innovation outcomes in Peru, thereby confirming a key role of government innovation agencies in the firm innovation process and firm strategies to reap the benefits of innovation. These results are in line with the literature (Basit et al., 2018; Clausen, 2009; Yao et al., 2015) Liu et al. (2019). propose U-shaped relationship between the amount of subsidies and firm innovation, where its effect decreases over time as the amount of subsidies available increases. Peru is characterized by a suboptimal level of R&D investment, of only 0.12% of GDP. Thus, government support of innovation, channeled through innovation subsidies, is limited. This could be explaining the positive relationship found, which contrasts Gustafsson et al.'s (2016) claims that innovation subsidies don't have an impact on innovation, as their study was conducted in Sweden.

Table 11
Bottlenecks

	Innovation Subsidy	Production Performance
0	NN	NN
10	NN	NN
20	NN	NN
30	NN	NN
40	NN	NN
50	NN	NN
60	NN	NN
70	3.4	NN
80	3.4	16.2
90	3.4	16.2
100	5.5	57.0

Source: Own elaboration. Note: NN = Not necessary

Table 12
NCA Effect Sizes

Construct	Effect Size	p-value
Production Performance	0.068	0.000
Innovation Subsidy	0.013	0.579

Source: Own elaboration

Table 10
Structural equation model results for indirect effects on Export Performance

Dependent variables	Original sample (O)	Standard deviation (STDEV)	T-statistics (|O/STDEV|)	p-values
Product innovation	0.169	0.041	4.129	0.000
Process innovation	0.115	0.039	2.954	0.002
Marketing innovation	0.085	0.037	2.321	0.010
Organizational innovation	-0.028	0.036	0.781	0.217

Regarding the other innovation inputs, human capital found mixed results, depending on the type of employee considered and innovation type. For technological innovation, both employee staff and laborer staff were found significant, while only organizational innovation found a positive and significant relation with professional staff. Surprisingly, both employee staff and professional staff negatively impact non-technological innovation, which could be explain in part due to the scarcity of qualified personnel, which explains why only professional staff had a positive effect (Crespi & Zuñiga, 2012; Heredia et al., 2018; Kostopoulos et al., 2011).

In terms of cooperation, a significant and positive relation was found with all four innovation types. This is in line with the literature on absorptive capacity (Zahra & George, 2002), which considers cooperation an antecedent to innovation (Nieto & Quevedo, 2005; Fosfuri & Tribo, 2008).

Furthermore, innovation types were positively related to production and export performance. In this case, we have found that different innovation types show distinct effects on production and export performance, which is in line with Damanpour & Aravind's (2011) claim innovation types vary in contribution to export performance. Surprisingly, process innovation was found to negatively affect export performance, although this value is rather small. This could be due in part to the fact that process innovation is intended to reduce production costs and increase productivity (Hwang et al., 2015). Therefore, process innovation impacts production performance positively in an initial phase. Nonetheless, the findings reveal that production performance mediates the relation between innovation types and export performance. This could be due to the fact that the probability of exporting is positively related to labor productivity (Cieslik et al., 2015; Wadho & Chaudhry, 2018). Moreover, the mediation between innovation types and export performance assumes a lag effect, as firms must first reap the benefits of innovation through increased productivity and production capacity and then leverage this into increased exports. These time- and resource-consuming activities explain the lag effect between the variables.

Conclusion

Overall, the findings support the theoretical model and the research objectives and provide theoretical, managerial, and policy implications. In terms of theoretical implications, this research contributes to the international business literature in Latin America, by assessing the effect of innovation on export performance. Developing countries, and those in Latin America specifically, remain poorly studied in terms of the effect of innovation on export performance; thus, this research adds to the knowledge on the effect of innovation subsidies awarded to SMEs. Likewise, the results reveal a positive relationship between innovation subsidy and innovation types, thereby contributing to the innovation policy literature and shedding light on the role and effectiveness of government innovation agencies.

Regarding practical implications, the results reveal the key role of innovation subsidies in promoting firm innovation and creating firm value, which is relevant for development policies. As subsidies impacts innovation, governments should promote innovation subsidies for SMEs, even in the context of developing markets, which are characterized by low levels of innovation. Moreover, the study adds to the understanding of innovation programs in non-OECD economies, in which we find an indirect effect between innovation and export performance. This finding stresses the need for convergence between innovation policy and export promotion policy; for example, policy makers could develop a specific initiative intended to support innovation solely for exporting SMEs.

This study has several limitations, which could open areas for future research. First, we used subjective measures to validate export performance, while not considering objective measures, such as exports or export intensity. Future research could build on our research model by incorporating additional export performance scale items and objective variables to measure export performance. For example, the use of scale measurements to identify radical and incremental innovations, as well as their interplay with performance, would add new insights.

Second, the use of dichotomous variables to measure innovation types undermines the interpretation of innovation as radical or incremental; scale measurements are necessary for this purpose. Third, the sample comprised innovation subsidies awarded to SMEs, and thus the generalizability of the finding to other Latin American economies may be limited. Future studies could replicate this research in other emerging economies, to validate the model under different institutional contexts. Finally, future research could address the relationships proposed in the research model through a longitudinal study, to further test for causality and obtain a deeper understanding of the relationships.

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