Journal of the Knowledge Economy
https://doi.org/10.1007/s13132-023-01305-w

Evaluating the Effects of Information Sources on Innovation Outcomes: Are There Differences between KIBS and Manufacturing Firms from a Latin America Country?

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Received: 1 March 2022 / Accepted: 25 February 2023

Abstract

The aim of this paper is analysing the relationships between sources (internal/external) of information and innovation outcomes (product, service and process) in Peruvian companies. Furthermore, we explore differences and similarities in these relationships when comparing manufacturing firms and knowledge-intensive business services (KIBS) firms. This study presents evidence based on the application of a logit model to a sample of 1141 Peruvian companies, comprising 830 manufacturing firms and 311 KIBS firms. Despite the fact that Peruvian companies do not tend to turn to external sources of information or invest in internal R&D activities, we find positive relationships between sources of information and innovation outcomes in both manufacturing firms and KIBS firms—predominantly process innovation in both cases, followed by product (goods) innovation for manufacturing firms and service innovation for KIBS. Our findings indicate that not all external sources of information have positive effects on product, service and process innovation. Thus, managers should consider proper management of the company's external relations in order to take advantage of these relationships. Moreover, policymakers should promote interrelationships between the actors in the innovation system (e.g., companies, research centres, universities, etc.) thereby generating opportunities for innovation. This paper provides evidence that the configuration of sources of information (especially internal R&D) plays a significant role in innovation outcomes in both manufacturing firms and KIBS firms, specifically in the context of Latin American countries.

Keywords Sources of information · Innovation outcomes · KIBS · Manufacturers · Peru

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Published online: 25 March 2023

Introduction

There is a well-established literature that holds that firms cannot generate innovation by relying solely on their internal knowledge and experience; innovation requires the acquisition of at least some external sources of information (Cassiman & Valentini, 2016). Thus, it is commonly assumed that accessing more information sources can help firms to boost their innovation (Laursen & Salter, 2006). However, different sources of information may be associated with different innovation outcomes (Amara & Landry, 2005). In this context, information from external sources is seen as a critical element in the innovation process because it can be complementary to organizations' internal knowledge (Párida et al., 2012); hence the relevance of the "open innovation paradigm" (Chesbrough, 2003). The open innovation literature indicates that companies turn to a variety of external sources to increase their innovation capabilities (e.g., Laursen & Salter, 2006; Cassiman & Valentini, 2016); however, to ensure that new information is suitable for firms' own purposes and that external information can be used in existing processes and products, firms are likely to rely on their own R&D (Audretsch & Belitski, 2022). Thus, this study analyses the effects of internal R&D activity as a complement to external sources of information. The extant literature recognizes R&D as one of the main determinants of innovation (Conte & Vivareli, 2014), however, in Latin American and Caribbean (LAC) economies, the production sector has historically shown low levels of R&D investment (ECLAC, 2022), meaning innovation gaps remain a problem (Viglioni et al., 2020). In this context, we contribute to the literature by determining whether internal R&D activities positively affect firms' innovation outcomes (especially for KIBS).

In recent decades, there has been a growing interest in the study of KIBS at an international level, due to the important role that they play in the business processes of their clients (Miles, 2005), especially in compensating for or complementing the innovation capabilities of their client companies (e.g., Seclen-Luna & Barrutia-Güenaga, 2018; Vaillant et al., 2021). In the regional and national economy, KIBS have played a central role in innovation, as carriers, producers and mediators of knowledge in innovation systems (e.g., Hsieh et al., 2015; Cooke & Leydesdorff, 2006). Furthermore, KIBS also play a very important role in the internationalization process of their clients (e.g., Miles & Seclen-Luna, 2022). Although the literature tends to assume that KIBS are innovative, there is evidence that not all KIBS are equally so (e.g., Rodriguez & Camacho, 2010). While this phenomenon is also of interest in Latin American countries (e.g., Rubalcaba et al., 2018; Seclen-Luna & Moya-Fernández, 2020), there are still relatively few related studies focusing on this region (Figueiredo et al., 2017). There are several reasons why Latin America provides a good context for studying this issue: for example, according to the 2019 World Bank indicators (World Bank, 2019), the region had an approximate GDP of US$6 trillion in 2017; furthermore, the region serves as "natural laboratory" for testing related theories originating from the USA and Europe (e.g., Aguinis et al., 2020; Vendrell-Herrero et al., 2017, 2021).

Based on the previous arguments, we raise three main research questions: 1) Are there positive relationships between internal R&D activities and innovation outcomes in manufacturing and KIBS firms in Peru? 2) Are there positive relationships between external sources of information and innovation outcomes in manufacturing and KIBS firms in Peru? 3) Are there differences between KIBS and manufacturing firms in terms of these relationships?

From a contextual perspective, this study contributes to the literature by demonstrating these relationships in a Latin American country such as Peru, which is subject to the influence of different factors than developed economies. Generally speaking, Peruvian companies face a large informal sector, a lack of financial resources to be able to develop their innovations, an innovation ecosystem still in its infancy, and poor links between the actors in its innovation ecosystem—Peru ranks 118th out of 141 countries in multi-stakeholder collaboration (World Economic Forum, 2019). Moreover, during the period 2015–2017, Peruvian manufacturing experienced a slight drop from 13.8% of GDP in 2015 to 13.1% in 2017, while KIBS have registered slight growth from 8.9% of GDP in 2015 to 9.3% in 2017. This trend has been accompanied by a large labour force in manufacturing (1.5 million in 2017), while the labour force working in KIBS firms has been rising, from 0.8 million in 2015 to 0.9 million in 2017 (PRODUCE, 2020). More recently, Peru's Ministry of Production has implemented public programmes to boost the role of KIBS in the Peruvian economy. Therefore, the KIBS industry is currently on the public agenda. All of the above justifies our comparison of the two industries.

Our original research uses a logit model with data from the 2018 National Survey of Innovation in the Manufacturing Industry and Knowledge-Intensive Business Services Companies (ENIIMSEC by its initials in Spanish) produced by Peru's Ministry of Production. Our empirical analysis is based on a sample of 1141 Peruvian companies, with 830 manufacturing firms and 311 KIBS firms. We explore multiple relationships between sources of information and innovation outcomes. The results show that the fact that firms consider an external source of information important to develop innovations does not guarantee that it will have a positive effect on all types of innovation. For example, a large proportion of companies in the sample (70%) use their suppliers as a source of information to implement innovations; however, this source only has positive effects on process innovation in manufacturing companies. Therefore, our study contributes to the understanding of these relationships in Peruvian manufacturing and KIBS firms.

The structure of the paper is as follows: The second section presents the literature review and develops the hypotheses. The third section details the datasets and tests the hypotheses. The empirical results are provided in the fourth section. Lastly, the fifth section provides some brief conclusions as well as discussing the limitations and suggestions for future research.

Literature Review and Hypothesis Development

In order to promote policies that enable companies to innovate more and achieve better performance, it is essential to analyse three common problems that arise in Latin American countries and that could be limiting the development and growth of their companies. First, there is a clear lack of R&D expenditure in LAC countries compared to more developed countries, and even in comparison to some emerging countries, such as China. Companies account for around 35% of R&D financing, while the State provides approximately 60% (ECLAC, 2022). This prompts us to question whether there is a relationship between the use of external sources of information and innovation outcomes. Second, despite efforts by governments to implement public programmes to promote collaboration between the actors in their innovation ecosystems—which has historically been poor—these countries are still a long way off achieving this goal (World Economic Forum, 2019). For example, looking at the multi-stakeholder collaboration indicator in The Global Competitiveness Report 2019, Paraguay ranks 127th out of 141 countries while Peru is in 118th position (World Economic Forum, 2019). Third, in Latin American countries it is not always clear what type of innovation outcomes should be promoted by public policies. Thus, companies may want to understand the approach to implementing process innovations rather than product innovations, or vice versa.

The present study analyses the three aforementioned issues in both manufacturing and KIBS firms. This cross-industry comparison is relevant because in Latin American countries there are several types of instruments to support business innovation, however, they involve horizontal funding with no sectoral or thematic priorities and are allocated on the basis of criteria such as the degree of innovation of the project and its expected financial sustainability (ECLAC, 2022). Therefore, based on the arguments made above, we formulate the hypotheses of the study (Fig. 1).

Innovation Outcomes

As companies possesses heterogenous resources and capabilities, they adopt different strategies to configure their innovation portfolio, that is, their innovation outcomes. The Oslo Manual (OECD & EUROSTAT, 2018) distinguishes between two main types of innovation: innovations that change the company's products, and innovations that change the company's processes. A product innovation is a new or improved good or service that differs from the company's previous goods or services and that has been brought to market. A business process innovation is a new or improved business process for one or more business functions (e.g., production, marketing, etc.) that differs significantly from the company's previous business processes and that has been implemented.

Despite the above classification, it is important to note that while the literature has predominantly focused on product and process innovation in manufacturing industries, there has been limited analysis of service innovation, although some studies have documented the relevance of service transition in manufacturing industries (Crozet & Milet, 2017). Consequently, existing typologies do not include service innovation in itself as a standard innovation category in manufacturing industries, meaning that the classification of service innovation in industrial settings has thus far been somewhat decontextualized (e.g., Opazo-Basáez et al., 2022). Hence, it should be noted that the analysis of goods and services must be done separately to understand their individual effects (Seclen-Luna & Alvarez-Salazar, 2021; Shin et al., 2022). That said, the literature also shows that

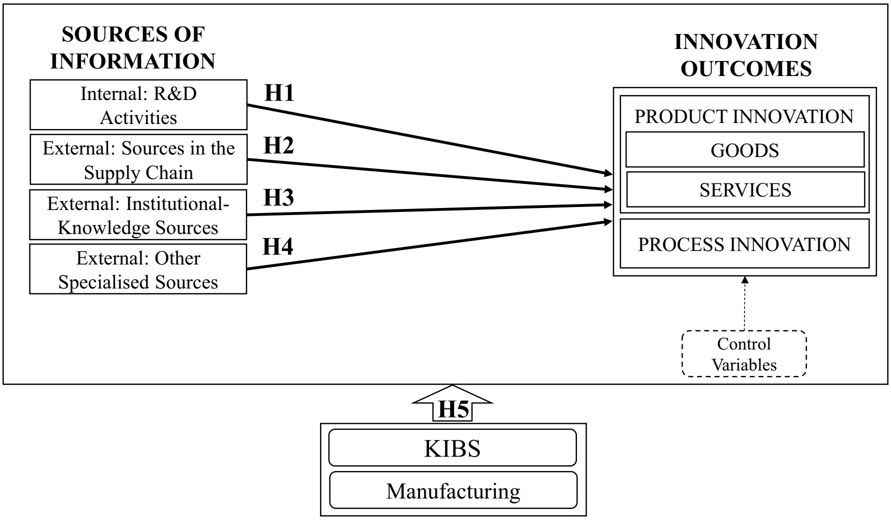

Fig. 1 Conceptual model

some companies actually bundle products and services into integrated solutions, generating a combined revenue stream (Davies, 2004). Under this approach, manufacturing firms implement services to boost the capabilities of the product, a phenomenon referred to as servitization (Crozet & Milet, 2017), while service firms add tangible components or products to their offering to standardize and enhance their overall efficiency through increased economies of scale, a phenomenon termed productization (Harkonen et al., 2015). Unfortunately, due to lack of available information on these phenomena in our research context, we do not evaluate the integrated solution approach in this study.

On the other hand, recent studies have recognized the importance of covering the new forms of process innovation by service firms (Witell et al., 2016). Technological issues have always been and continue to be a key focus for technology-based KIBS, however, we are seeing the increasing importance of technology for professional KIBS. For example, the rise of big data in general and the analytical treatment to process these data create opportunities for professional service firms to offer new services. The intensification of the use of technology thus forces professional KIBS to make extra investments that may have important ramifications for the forms of innovation developed or delivered (Doloreux & Frigon, 2020).

Empirical evidence shows that firms from the Latin American region typically engage in incremental innovation based on product imitation (Juliao-Rossi et al., 2020) and that technology acquisition tends to be the main innovation strategy for companies (Goedhuys & Veugelers, 2012). Thus, taking into account the aforementioned arguments, we follow the Oslo Manual (OECD & EUROSTAT, 2018) and focus on innovation outcomes: namely, product innovation (goods and services), and process innovation.

Internal R&D and Innovation Outcomes

The extant literature generally identifies R&D as one of the main determinants of successful innovation (e.g., Conte & Vivarelli, 2014), especially for manufacturing firms (Becheikh, Landry & Amara, 2006). However, some studies argue that it can have negative effects if the R&D is purely internal (e.g., Tsai, Hsieh & Hultink, 2011). These authors highlight the need to use external knowledge (such as licenced products or acquisition of technology) to avoid excessive dependence on internal R&D, which can lead to an organizational 'myopia' where only local solutions are sought. Therefore, internal and external sources of information may be complementary to one another; in fact, some authors identify a positive relationship between R&D activities and the use of external sources of information (Anzola-Román et al., 2018).

Furthermore, some authors point out similarities and differences between R&D conducted by (technology-intensive) manufacturing firms and by some service industries (e.g., Ettlie & Rosenthal, 2011), reporting that R&D plays a minor role for KIBS in comparison to manufacturing firms (Freel, 2006), which can lead to differences between them in terms of types of innovation (Koch & Strotmann, 2008). Notwithstanding, R&D activity in services is increasing and there is evidence that R&D is a driver of service innovation, with it being seen as an effective way to develop new knowledge inside of these firms (e.g., Doloreux et al., 2016). Thus, investments in R&D are associated with product and process innovation in KIBS depending on their knowledge-bases (Pina & Tether, 2016).

Even though there are few studies on R&D in the Latin American region (Viglioni et al., 2020), some evidence has been reported that internal R&D activities have positive effects on product and process innovation in South American manufacturing firms (Chudnovsky et al., 2006; Heredia-Pérez et al., 2019; Seclen-Luna & Morales, 2022). Unfortunately, the topic of R&D in services in the region remains underexplored (Aboal et al., 2015). Therefore, this study contributes to the body of evidence on this matter in KIBS firms. Based on these arguments, we thus propose the following hypotheses:

H1a: There is a positive relationship between internal R&D activities and innovation outcomes (goods, services and process) of manufacturing companies.
H1b: There is a positive relationship between internal R&D activities and innovation outcomes (goods, services and process) of KIBS firms.

External Sources of Information and Innovation Outcomes

The open innovation literature points to external sources of information as a mechanism that potentially fosters the development of innovation capacity in companies (e.g., Cassiman & Veugelers, 2006). Most studies on this matter have focused on manufacturing firms (e.g., Amara & Landry, 2005; Obradovic et al., 2021), however, there is a growing number of studies on KIBS firms (e.g., Freel, 2006; Rodríguez et al., 2017), mainly in developed countries. Consequently, a large body of research has focused on gaining a better understanding of the advantages and disadvantages of external sources of information. One of the main advantages of external sources is that they can help generate positive innovation returns (Laursen & Salter, 2006). However, findings on the nature of these relationships remain inconclusive (Cheng & Shiu, 2015). In fact, some authors argue that open innovation has limitations (Trott & Hartmann, 2009) or that in certain contexts it is preferable to innovate in isolation (Deichmann & Jensen, 2018; Manzzini et al., 2017). Therefore, there is still an important debate around the paradigm of open innovation, and relatively few studies on these issues in Latin American countries for manufacturing firms (Obradovic et al., 2021) and for knowledge-intensive business services (KIBS) firms (Vivas & Barge-Gil, 2015).

There are many ways to classify external sources of information (e.g., Doloreux et al., 2018; Rodríguez et al., 2017; Laursen & Salter, 2006; Amara & Landry, 2005), with some similarities across studies. Usually, the different types of information sources can be categorized as: 1) sources in the supply chain (e.g., customers, suppliers, and competitors), 2) institutional-knowledge sources (e.g., research centres, universities, etc.) and 3) other specialized sources (e.g., specialized journals, conferences, trade fairs, consultants, business associations, patent databases, etc.).

Sources in the Supply Chain

The seminal work of Von Hippel (1976) highlights the importance of information from customers or users to innovating in companies. Smart manufacturing shows how the role of the customer is currently key in this process (Morgan, Anokhin & Wincent, 2019). Moreover, service innovation in manufacturing firms involves continuous engagement with customers (Vendrell-Herrero et al., 2021). For service companies, one of their fundamental features is the importance of the relationship with their clients (Pina & Tether, 2016). In this sense, KIBS acquire knowledge from customers' businesses and improve their services based on customer needs (Bettencourt et al., 2002). Indeed, studies that focus on innovation in KIBS highlight the relevant role played by their clients in improving their processes or services (e.g., Rodríguez et al., 2017; Leiponen, 2005).

Information from suppliers also contributes to the implementation of innovations. For example, suppliers help in new product development, especially by solving technical problems in manufacturing firms (Tsai & Hsieh, 2009). Manufacturers also rely on suppliers to develop new service capabilities (Bustinza et al., 2021). Moreover, suppliers can be important partners, providing knowledge for technology adoption (e.g., Seclen-Luna et al., 2022; Vaillant et al., 2021), especially in Latin American countries (Goedhuys & Veugelers, 2012). For service companies, suppliers are a relevant source of knowledge (Leiponen, 2005), and they also help KIBS to improve their processes and services (Rodríguez et al., 2017). The literature notes that close and intense cooperation between suppliers and their clients helps those companies to better meet customer needs and gain profound market knowledge.

Lastly, information from competitors may contribute to innovation in companies through R&D collaborations. However, studies on the collaboration between companies and their competitors have generated fierce debate (Guzzini et al., 2018), especially in the context of the opportunistic behaviour that can occur when sharing the economic results of collaboration, due to problems of information asymmetry and selection bias (Nieto & Santamaría, 2007). Empirical evidence is diverse and inconclusive: for example, Littunen et al. (2021) found that customers, suppliers and competitors were not linked to the introduction of a different type of innovation in either manufacturers or KIBS in Finland, whereas Leiponen (2005) analysed the joint effect of information sourced from customers and competitors on KIBS innovation, finding positive impacts. Nonetheless, some studies argue that since it is easier to copy new services than products, cooperation between KIBS competitors will be limited (Freel, 2006). Therefore, further exploration of these issues is needed.

In the context of Latin American countries, recent studies on innovation in low-tech Peruvian manufacturing companies have found that customers, suppliers and competitors are the main external sources that help companies to develop product and process innovation (Del Carpio-Gallegos & Seclen-Luna, 2022). Regarding service firms, Crespi and Vargas (2015) concluded that market sources of information are not associated with any innovation by KIBS firms from Chile, Colombia and Uruguay. Thus, based on these arguments, we propose the following hypotheses:

H2b: There is a positive relationship between the use of suppliers as a source of information and companies' innovation outcomes (goods, services and process).
H2c: There is a positive relationship between the use of competitors as a source of information and companies' innovation outcomes (goods, services and process).

Institutional-Knowledge Sources

Institutional knowledge comes from government R&D agencies, universities, and academic research institutes (Laursen & Salter, 2006). Empirical evidence has shown that the use of knowledge from universities and research organizations is positively associated with innovation in companies (Vivas & Barge-Gil, 2015). For instance, Ozdemir et al. (2017) analysed manufacturing firms alliances with suppliers, competitors and research institutions. Their study found no effect from suppliers but showed that alliances with competitors and particularly research institutions provide access to a broader knowledge-base and greater know-how that can be used to develop different types of new products. The positive role of universities and research organizations as sources of new knowledge is also emphasized (e.g., Pinto et al., 2015; Caloghirou et al., 2021). Some authors even report that mere access to information provided by universities and research institutions has a positive influence on the development of radical innovations in KIBS (e.g., Koch & Strotmann, 2008).

Nevertheless, the role played by universities and research organizations in KIBS innovation activity is considered relatively minor in comparison with their role in the manufacturing industry (Wong & He, 2005). In fact, some researchers have even found a negative effect of universities on KIBS' innovation (Littunen et al., 2021), especially product innovation (Doloreux et al., 2018). In that sense, most research carried out at universities is probably difficult to commercialize (Tether & Tajar 2008). According to these authors, the innovation process involves more tacit knowledge from customers, suppliers or competitors than codified knowledge from universities and R&D laboratories.

This perception is more common in many Latin American countries, where the informal sector is huge, there is a shortage of highly qualified labour, innovation systems are not usually mature, and companies tend to believe that universities respond slowly or not at all to company's needs (Wang & Lin, 2018). Nevertheless, the fundamental problem for Latin American countries is that even if their universities produce innovative results that advance the science in several areas, it is difficult to transfer that knowledge to the production system (ECLAC, 2022). Thus, based on these arguments, we propose the following hypothesis:

H3: Universities are not positively associated with the innovation outcomes (goods, services and process) of companies in the context of a Latin American country.

Other Specialized Sources

Journals, conferences, trade fairs, consultants, and business associations can be important information sources that inspire or drive firms' innovation outcomes (e.g., Escribano et al., 2009; Chichkanov et al., 2021). Some studies have found evidence that companies which attend trade fairs (e.g., Littunen et al., 2021) and conferences (e.g., Doloreux et al., 2018) can increase their likelihood of creating product innovation. However, other studies did not find empirical evidence to support this relationship in KIBS (e.g., Rodríguez et al., 2017; Doloreux & Frigon, 2020). Business associations enable firms, especially small ones, to gain access to knowledge that is different from that provided by market actors and institutions (Khanna & Rivkin, 2006). In the context of Latin American countries, scientific journals and professional associations can improve product and process innovation in manufacturing firms (e.g., Del Carpio-Gallegos & Seclen-Luna, 2022; Heredia-Perez et al., 2019). Regarding service firms, Crespi and Vargas (2015) concluded that scientific sources of information are not associated with any innovation by KIBS firms from Chile, Colombia and Uruguay. Thus, based on these arguments, we hypothesise:

H4a: There is a positive relationship between the use of business associations as a source of information and companies' innovation outcomes (goods, services and process).
H4b: There is a positive relationship between the use of consultants as a source of information and companies' innovation outcomes (goods, services and process).
H4c: There is a positive relationship between the use of conferences as a source of information and companies' innovation outcomes (goods, services and process).
H4d: There is a positive relationship between the use of publications as source of information and companies' innovation outcomes (goods, services and process).

Industry Effects on Sources of Information and Innovation Outcomes

Given that the nature of innovation can vary considerably between economic sectors (Castellacci, 2008), a cross-industry comparative analysis can be appropriate for understanding differences in innovation studies in primary industries (e.g., Aquilante & Vendrell-Herrero, 2021). The literature has found that product and process innovation is more common in manufacturing companies than in service firms (e.g., Mohnen & Hall, 2013). Nevertheless, empirical studies have highlighted that a higher degree of openness to external sources of information improves innovation performance both in the manufacturing industry (e.g., Wang et al., 2012) and in KIBS (e.g., Rodríguez et al., 2017), mainly in developed countries. This study is thus particularly useful due to the scarcity of evidence on the role of external sources of information in service companies' innovation outcomes in Latin American countries (e.g., Vivas & Barge-Gil, 2015). Furthermore, the cross-industry comparison is relevant because in Latin American countries there are several types of instruments to support business innovation, but they involve horizontal funding with no sectoral or thematic priorities and are allocated on the basis of criteria such as the degree of innovation of the project and its expected financial sustainability (ECLAC, 2022). Therefore, the cross-industry comparisons performed in this study are aimed at shedding light on the differences between manufacturing and KIBS firms in their use of sources of information to achieve innovation outcomes. Thus, based on these arguments, we propose the following hypothesis:

> **H5:** Manufacturing firms have a greater positive effect on the relationship between the use of sources of information and innovation outcomes (goods, services and process) than KIBS firms.

Methodology

Data Description

The data used in the study comes from the Peruvian survey ENIIMSEC produced in 2018. The information is collected by the National Institute of Statistics and Information every three years. The 2018 ENIIMSEC includes data from 2015 to 2017 and uses random sampling stratified by location, industry, and company size. The final sample of the survey was 2229 companies, with 1541 manufacturing companies and 688 KIBS. Basically, the present study focuses on those companies that have implemented product (goods), service and process innovations, and have used sources of information to achieve their innovation outcomes. Using these criteria, we included 1141 companies in our sample, with 830 manufacturing firms and 311 KIBS firms.

Using sub-samples to estimate moderation effects is an approach that has been used in previous studies; see, for example, Gomes et al. (2018) and Vendrell-Herrero et al. (2022). In addition, it is important to mention that due to the available data in the survey related to our conceptual model, we cannot split the sample by categories of industrial activity in either the manufacturing or the KIBS industry, because there are missing data which could affect the consistency of the models proposed in the study.

Description of Variables

Based on the questionnaire, two groups of variables can be identified. The first set of variables is made up of innovation outcomes, while the second group is related to sources of information. The three dependent variables are product (goods) innovations, service innovations and process innovations. To measure these variables, we considered three questions in the ENIIMSEC survey: (1) "During the 2015-2017 period, did your company improve products (goods) or introduce new ones into the market?", (2) "During the 2015-2017 period, did your company improve or introduce new services?", (3) "During the 2015-2017 period, did your company improve or introduce new processes?". Regarding the independent variables, we consider the different sources of information that companies have linked to or used to achieve innovation outcomes. We measure these external sources of information based on answers to the following question from the survey: "What was the degree of importance of each of the following sources of information that your company used for the development of innovations during the 2015-2017 period?" For these variables we thus use ordinal scales, as has been done in previous studies, both for manufacturing companies (e.g., Del Carpio-Gallegos & Seclen-Luna, 2022) and for KIBS companies (e.g., Rodríguez & Camacho, 2010).

As control variables, we include intellectual property activities, firm size and firm age. Intellectual property activities, such as the acquisition of rights for the use of patents, licences and utility models, have a positive effect on the development of a new product (see, e.g., Doloreux & Frigon, 2020; Seclen-Luna & Morales, 2022, in the context of Latin American countries). The latter is captured as a dichotomous variable. Furthermore, the extant literature shows that large enterprises have traditionally been in a better position to exploit innovation outcomes, due to the fact that they have easier access to external funding for innovation and to cover the fixed costs of the R&D activities needed for the development of new products (Shefer & Frenkel, 2005). However, in some cases, SMEs show high levels of innovation performance (Stock, Greis & Fischer, 2002). This is generally consistent with the experience accumulated over time, however, there is evidence that shows younger firms invest more in R&D than older firms do (Mariev et al., 2022). Firm size is measured by the number of employees and firm age as the number of years since its foundation year, both expressed as the logarithm (e.g., Del Carpio-Gallegos & Seclen-Luna, 2022) (Table 1).

Method and Tests

In accordance with our research objectives, we estimated the effects of sources of information on firms' innovation outcomes. The descriptive data and regression models were computed using R software. To test the hypotheses, we used logit models which were specified as follows:

$$Y(Innov)_{i,j} = \beta_0 + \beta_1 Sources_{i,j} + \vartheta_{i,j} + \varepsilon_{i,j} \quad (1)$$

Where the subscript i refers to manufacturing companies and the subscript j refers to KIBS firms. $Y(Innov)_{i,j}$ is the innovation outcome, which can be a product (goods), services or process innovation. $Sources_{i,j}$ refers to each of the sources of information considered in the model. $\vartheta_{i,j}$ is a vector of company characteristics that includes intellectual property, firm size and firm age. $\varepsilon_{i,j}$ is the error term. To support the hypotheses, β_1 needs to be positive.

Results and Discussion

Descriptive Statistics

Table 2 shows the statistical summary according to the industries analysed. These results indicate that companies in both industries are predominantly process innovation-oriented, followed by product (goods) innovation for manufacturing firms and service innovation for KIBS. In any case, very few manufacturing firms implement service innovation and very few KIBS implement product (goods) innovation.

The lack of relevant data means unfortunately we cannot analyse whether companies bundle products (goods) and services into integrated solutions. Regarding the sources of information, a small proportion of the companies have used internal R&D and universities; however, companies consider the former is considered to be the most important source of information and the latter the least important. This result is consistent with previous studies (e.g., Heredia-Pérez et al., 2019) that show that, in a context of immature innovation ecosystems, R&D activities and universities may not be attractive for companies. Furthermore, it can be seen that the sources in the supply chain are the most used by companies; specifically, suppliers (70%), customers (66%) and competitors (58%). With respect to other specialized sources, it seems that companies in the total sample are moderately interested in conferences (50%) and publications in journals (46%), mainly to achieve innovation outcomes. However, there are slight differences between manufacturers and KIBS firms, with the former registering greater use of these sources of information than the latter. Therefore, it could be argued that manufacturers are more prone to openness than KIBS firms. In any case, generally speaking, it can be seen that a small proportion of Peruvian companies use these external sources of information.

Hypothesis Testing

In this section, we estimate the effects of the sources of information on innovation outcomes, using an appropriate indicator to check the significance of the model (McFadden's Pseudo R^2). In general terms, although the values of this indicator are low, the results are consistent with previous studies that rely on low values of McFadden's R^2, such as those of Doloreux et al. (2016), Rodríguez et al. (2017), Doloreux et al. (2018), Gomes et al. (2018), Vendrell-Herrero et al. (2018), Doloreux and Frigon (2020), Littunen et al. (2021), Vendrell-Herrero et al. (2021), and Audretsch and Belitski (2022), among others. Additionally, we

Table 1 Definition and measurement of variables

Variable	Definition	Scales	Hypotheses
Dependent Variables	(Innovation Outcomes)		
Product Innovation	A value of 1 indicates that the firm introduced any new or significantly improved tangible product or goods (e.g., materials, devices, technologies), in the analysed three-year period. 0 otherwise	Dichotomous	
Service Innovation	A value of 1 indicates that the firm introduced any new or significantly improved service (e.g., use of QR to take orders for manufacturing firms and provide new laboratory test for KIBS firms), in the analysed three-year period. 0 otherwise	Dichotomous	
Process Innovation	A value of 1 indicates that the firm introduced any new or significantly improved processes (e.g., method of production of goods or provision of services, method of logistics or order processing, means or techniques for promoting the product or services), in the analysed three-year period. 0 otherwise	Dichotomous	
Independent Variables	(Sources of Information)		
Internal R&D	The importance of internal R&D for achieving innovation outcomes in the firm in the analysed three-year period: a value of 3 indicates high, 2 medium, 1 low and 0 none.	Ordinal	H1: There is a positive relationship between internal R&D and innovation outcomes
Customers, suppliers, and competitors	The importance of each one of these sources of information from the supply chain for achieving innovation outcomes in the firm in the analysed three-year period: a value of 3 indicates high, 2 medium, 1 low and 0 none.	Ordinal	H2: There is a positive relationship between customer/supplier/competitor sources and innovation outcomes

Table 1 (continued)

Variable	Definition	Scales	Hypotheses
Universities	The importance of universities for achieving innovations in the firm in the analysed three-year period: a value of 3 indicates high, 2 medium, 1 low and 0 none.	Ordinal	H3: Universities are not positively associated with innovation outcomes
Business associations, Consultants, Conferences, Publications	The importance of each one of the other specialized sources for achieving innovations in the firm in the analysed three-year period: a value of 3 indicates high, 2 medium, 1 low and 0 none.	Ordinal	H4: There is a positive relationship between the use of other specialized sources and innovation outcomes
Control Variables			
Intellectual Property Activities	A value of 1 indicates that the firm carried out activities such as the acquisition of rights for the use of patents, licences, utilities models to achieve innovation outcomes. 0 otherwise	Dichotomous	
Firm size	Number of workers (permanent full-time worker)	Logarithm	
Firm age	Time from foundation of the firm (except firms with three or less years)	Logarithm	

Table 2 Summary of statistics for companies (Percentage)

Variable	Total Sample		Manufacturing		KIBS	
	Obs.	Mean	Obs.	Mean	Obs.	Mean
Dependent (Innovation Outcomes)						
Product Innovation (Goods)	1141	0.2340	830	0.3036	311	0.0482
Service Innovation	1141	0.1201	830	0.0819	311	0.2219
Process Innovation	1141	0.5127	830	0.5795	311	0.3344
Independent (Sources of Information) *						
Hypothesis 1. Internal Source						
Internal R&D	1141	0.2603 (2.24)	830	0.2892	311	0.1833
Hypothesis 2. Supply Chain Sources						
Customers	1141	0.6626 (1.55)	830	0.6639	311	0.6592
Suppliers	1141	0.7090 (1.61)	830	0.7120	311	0.7010
Competitors	1141	0.5802 (1.19)	830	0.6000	311	0.5273
Hypothesis 3. Institutional Source						
Universities	1141	0.2699 (0.45)	830	0.2855	311	0.2283
Hypothesis 4. Other Specialized Sources						
Business Associations	1141	0.3129 (0.53)	830	0.3265	311	0.2765
Consultants	1141	0.3514 (0.64)	830	0.3735	311	0.2926
Conferences	1141	0.5066 (1.12)	830	0.5434	311	0.4084
Publications in Journals	1141	0.4619 (0.93)	830	0.4855	311	0.3987
Controls						
Intellectual Property Activities	1141	0.1350	830	0.1494	311	0.0964
Size (Workers)	1141	303.9334	830	319.0120	311	263.6913
Age	1141	21.4943	830	23.8590	311	15.1833

**Although this table calculates the percentages of companies that use the information sources, the importance they assign to the use of each is in parenthesis for ordinal variables*

conducted a Hosmer-Lemeshow goodness-of-fit test and Area under the ROC curve. The non-significance of the Hosmer-Lemeshow test indicates a good fit of the models, while the value of the C-statistic is above the commonly-accepted threshold (0.7) for the regressions with the dependent variables' product innovation and service innovation, and very close to the threshold in the regressions for process innovation.

For the analysis, we follow the literature that suggests analysing product innovation—goods and services— separately in order to understand their individual effects (e.g., Opazo-Basáez et al., 2022; Seclen-Luna & Alvarez-Salazar, 2021). First, regarding product (goods) innovation (Table 3), and focusing on the total sample (23% of the total sample developed this type of innovation), the results indicate that internal R&D ($p<0.01$) and conferences ($p<0.1$) positively affect the development of product (goods) innovation, mainly in older companies. Hence, this result supports H1a, H1b and H4c. Nevertheless, we see different results when focusing on industry sub-samples. On the one hand, in manufacturing firms (30% of manufacturing firms developed products or goods), internal R&D ($p<0.01$), customers ($p<0.05$) and consultants ($p<0.1$) positively affect the development of products or goods. According to the marginal effects, if the rest of the variables remain constant (ceteris paribus), a 1% increase in R&D activities leads to an increase of 0.247 percentage points in the likelihood of develop a product or goods ($p<0.01$). Consequently, the results in Table 3 support H1a, H2a and H4b, and are consistent with previous studies that show R&D activities have positive effects on product innovation (e.g., Becheikh et al., 2006), especially in South American manufacturing firms (e.g., Heredia-Pérez et al., 2019). Also, these results corroborate other studies that highlight the role of customers and consultants in the development of products or goods in Peruvian manufacturing firms (e.g., Del Carpio-Gallegos & Seclen-Luna, 2022).

On the other hand, although only 4% of KIBS firms developed products or goods, internal R&D ($p<0.1$), competitors ($p<0.05$) and conferences ($p<0.01$) positively affect the development of products or goods. According to the marginal effects, if the rest of the variables remain constant, a 1% increase in R&D activities leads to an increase of 0.058 percentage points in the likelihood of developing a product or goods ($p<0.05$). Consequently, the results in Table 3 support H1b, H2c, and H4c, and corroborate previous studies that find R&D activities (e.g., Doloreux et al., 2016), competitors (e.g., Leiponen, 2005) and conferences (e.g., Doloreux et al., 2018) have positive effects on the development of product innovation in KIBS firms. However, universities ($p<0.1$) and customers ($p<0.1$) have a statistically significant negative effect. That means that universities may have difficulties in transferring knowledge to the production system (ECLAC, 2022); previous studies (e.g., Littunen et al., 2021) have shown similar negative effects. As such, this result supports H3. One reason for this may be that 22% of KIBS have linked with universities to produce an innovation. Furthermore, contrary to our expectations, even though 65.9% of KIBS have used customers to develop innovations, it can be seen that customers have a statistically significant negative effect on innovation of products or goods. This may be because KIBS do not bundle products and services into an integrated solution, or because customers are mainly linked to developing service innovations, as confirmed later. Thus, this result does not support H2a, and conflicts with some evidence found in the literature (e.g., Bettencourt et al., 2002; Rodríguez et al., 2017). In addition, intellectual property activities are found to be positively associated with all these relationships in both manufacturing and KIBS firms.

Second, regarding service innovation (Table 4), when focusing the analysis on the total sample (12% of the total sample developed this type of innovation), the results indicate that customers ($p<0.01$) and consultants ($p<0.05$) positively affect the development of service innovation, mainly in smaller companies. Hence, this result supports hypotheses H2a and H4b. Nevertheless, when the analysis focuses on the industry sub-samples, we find different results. On the one hand, in manufacturing firms (8% of manufacturing firms developed an innovation in services), customers ($p<0.05$), business associations ($p<0.1$) and consultants ($p<0.1$) positively affect the development of service innovations. According to the marginal effects, if the rest of the variables remain constant, a 1% increase in the link with customers leads to an increase of 0.019 percentage points in the likelihood of developing a service innovation ($p<0.05$). Consequently, the results in Table 4 support H2a,

Table 3 Product Innovation (Goods) Regression Models

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
Internal R&D	1.3820***	0.2034***	1.4512***	0.2471***	1.5289**	0.0586**
	0.1694	0.0224	0.1898	0.0279	0.7194	0.0283
Customers	0.1174	0.0173	0.2026**	0.0345**	−0.5442*	−0.0209*
	0.0748	0.0110	0.0818	0.0138	0.2845	0.0112
Suppliers	0.0022	0.0003	0.0518	0.0088	−0.1875	−0.0072
	0.0728	0.0107	0.0790	0.0134	0.2980	0.0115
Competitors	0.0420	0.0062	−0.0326	−0.0056	0.7003**	0.0269**
	0.0783	0.0115	0.0861	0.0147	0.2960	0.0116
Universities	−0.0349	−0.0051	0.0130	0.0022	−0.9458*	−0.0363*
	0.1001	0.0147	0.1119	0.0191	0.5100	0.0200
Business Associations	−0.0290	−0.0043	0.0035	0.0005	−0.3544	−0.0136
	0.1020	0.0150	0.1110	0.0189	0.3948	0.0152
Consultants	0.1587	0.0234	0.2016**	0.0343**	0.0900	0.0035
	0.0857	0.01256	0.0940	0.0159	0.3087	0.0119
Conferences	0.1667**	0.0245**	0.0788	0.0134	0.8759***	0.0336***
	0.0793	0.0116	0.0864	0.0147	0.2948	0.0118
Publications in Journals	0.06377	0.0094	0.0971	0.0165	−0.2024	−0.0078
	0.0874	0.0128	0.0950	0.0161	0.3122	0.0120
Intellectual Property Activities	0.8045***	0.1184***	0.6856***	0.1167***	1.5427**	0.0591**
	0.2013	0.2894	0.2215	0.0370	0.0738	0.0287
log (Size)	−0.0012	0.0001	−0.0448	−0.0076	−0.1834	−0.0070
	0.0521	0.0077	0.0596	0.0101	0.2026	0.0078

Table 3 (continued)

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
log (Age)	0.2481**	0.0365**	−0.0175	−0.0030	−0.6351	−0.0244
	0.1191	0.0174	0.1342	0.0229	0.5258	0.0204
(Intercept)	−3.1212***		−1.9449***		−1.9331	
	0.3781		0.4192		1.4852	
Observations	1141		830		311	
Pseudo R^2	0.1531		0.1571		0.2619	
Log-Likelihood	−525.7235		−429.46582		−44.3662	
Area under ROC	0.7580		0.7622		0.8874	
Wald Chi^2 ($Prob>Chi^2$)	0.0000***		0.0000***		0.0017***	
Hosmer-Lemeshow (Prob > chi2)	0.7820		0.6039		0.9289	

***$p<0.01$; **$p<0.05$; *$p<0.1$

H4a and H4b, and are consistent with previous studies that show customers (e.g., Vendrell-Herrero et al., 2021), business associations (e.g., Khanna & Rivkin, 2006) and consultants (e.g., Bustinza et al., 2021) have positive effects on service innovation in manufacturing firms. Nevertheless, it is important to note that intellectual property activities are positively associated with all these relationships in manufacturing firms. One reason for this may be that these activities are more closely related to product (goods) innovation than service innovation, and in turn may be affected by the low proportion of companies (14%) that carry out these activities. On the other hand, in KIBS firms (22% of KIBS developed services), internal R&D ($p<0.01$) and customers ($p<0.1$) positively affect the development of service innovations. According to the marginal effects, if the rest of the variables remain constant, a 1% increase in R&D activities leads to an increase of 0.150 percentage points in the likelihood of developing a service innovation ($p<0.01$). Consequently, the results in Table 4 support H1a and H2a, and are consistent with previous studies that show R&D activities (e.g., Pina & Tether, 2016) and customers (e.g., Bettencourt et al., 2002; Rodríguez et al., 2017) have positive effects on the development of service innovation in KIBS firms.

Second, regarding service innovation (Table 4), if the analysis is focused on the total sample – 12% of the total sample developed this innovation-, the results indicate that customers ($p<0.01$) and consultants ($p<0.05$) affect positively to develop service innovation mainly in smaller companies. Hence, this result support hypotheses H2a and H4b. Nevertheless, when the analysis is taking into account the moderation of the industries, it is possible to find different results. On the one hand, in manufacturing firms (8% of manufacturing developed services), customer ($p<0.05$), business associations ($p<0.1$) and consultants ($p<0.1$) affect positively to develop service innovations. According to marginal effects and considering that the rest of the variables remain constant (et ceteris paribus), an increase of 1% in the link with customer leads to an increase of 0.019 percentage points in the likelihood of develop a service ($p<0.05$). Consequently, the results in Table 4 validate H2a, H4a and H4b. Thus, the results are consistent with previous studies that show customers (e.g., Vendrell-Herrero et al., 2021), business associations (e.g., Khanna & Rivkin, 2006) and consultants (e.g., Bustinza et al., 2021) have positive effects on service innovation in manufacturing firms. Nevertheless, it is important to note that intellectual property activities are not associated positively with all these relationships in manufacturing firms. Perhaps, one reason for this is that these activities are more related to product (goods) innovation than service innovation, and in turn may be affected by the low proportion of companies (14%) that carry out these activities. On the other hand, in KIBS firms (22% of KIBS developed services), internal R&D ($p<0.01$) and customers ($p<0.1$) affect positively to develop service innovations. According to the marginal effects, if the rest of the variables remain constant, a 1% increase in R&D activities leads to an increase of 0.150 percentage points in the likelihood of developing a service innovation ($p<0.01$). Consequently, the results in Table 4 support H1a and H2a, and are consistent with previous studies that show R&D activities (e.g., Pina & Tether, 2016) and customers (e.g., Bettencourt et al., 2002; Rodríguez et al., 2017) have positive effects on the development of service innovation in KIBS firms.

Third, regarding process innovation (Table 5), when the analysis is focused on the total sample, the results indicate that internal R&D ($p<0.01$), suppliers ($p<0.01$),

Table 4 Service Innovation Regression Models

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
Internal R&D	0.2387	0.0236	−0.0925	−0.0065	1.0002***	0.1502***
	0.2201	0.0218	0.3106	0.0218	0.3514	0.0504
Customers	0.2757***	0.0273***	0.2939**	0.0193**	0.2695*	0.0405*
	0.0949	0.0094	0.1350	0.0096	0.1417	0.0210
Suppliers	0.1205	0.0119	0.1220	0.0086	0.0250	0.0038
	0.0913	0.0090	0.1280	0.0090	0.1426	0.0214
Competitors	−0.0061	−0.0006	−0.1092	−0.0077	0.1452	0.0218
	0.0955	0.0094	0.1360	0.0096	0.1467	0.0219
Universities	0.1227	0.0121	0.1447	0.0102	0.1129	0.0169
	0.1173	0.0116	0.1638	0.0115	0.1862	0.0279
Business Associations	0.1378	0.0136	0.2729*	0.0192*	−0.0670	−0.0101
	0.1195	0.0118	0.1575	0.0111	0.2060	0.0309
Consultants	0.2258**	0.0223**	0.2703*	0.0190*	0.2388	0.0358
	0.1019	0.0101	0.1388	0.0098	0.1676	0.0249
Conferences	−0.0683	0.0067	0.0197	0.0014	−0.1025	−0.0154
	0.1020	0.0101	0.1399	0.0098	0.1670	0.0250
Publications in Journals	0.1763	0.0174	0.1822	0.0128	0.1882	0.0283
	0.1074	0.0106	0.1459	0.0102	0.1761	0.0263
Intellectual Property Activities	−0.7105**	−0.0703**	−1.2733**	−0.0895**	0.1930	0.0290
	0.3115	0.0308	0.4926	0.0350	0.4758	0.0714
log(Size)	−0.1438**	−0.0142**	−0.1430	−0.0101	−0.0617	−0.0093
	0.0642	0.0063	0.0923	0.0065	0.0919	0.0138

Table 4 (continued)

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
log(Age)	−0.1054	−0.0104	0.1144	0.0080	0.3269	0.0491
	0.1457	0.0144	0.2111	0.0149	0.2478	0.0369
(Intercept)	−2.2103		3.2786***		−3.0574***	
	0.4428		0.6680		0.7593	
Observations	1141		830		311	
Pseudo R^2	0.0767		0.0946		0.1154	
Log-Likelihood	−386.6963		−213.0022		−145.6113	
Area under ROC	0.7131		0.7418		0.7392	
Wald Chi^2 ($Prob>Chi^2$)	0.0000***		0.0000***		0.0002***	
Hosmer-Lemeshow (Prob > chi2)	0.3732		0.2844		0.8337	

$^{***}p<0.01$; $^{**}p<0.05$; $^{*}p<0.1$

competitors ($p < 0.01$), conferences ($p < 0.01$) and publications ($p < 0.05$) positively affect the development of process innovation in companies. Hence, this result supports hypotheses H1a, H1b, H2b, H2c, H4c and H4d. Nonetheless, even though 66% of companies have used links to customers to develop innovations, we surprisingly find that customers have a statistically significant negative effect on process innovation. Thus, this result does not support hypothesis H2a, and contradicts some evidence in the literature (e.g., Morgan et al., 2019). One reason for this may be that Peruvian companies are not yet implementing customized production process, and that customers are more closely linked to product and service innovation than process innovation, mainly in manufacturing firms. Nevertheless, when the analysis takes into account the moderating effect of the industries, we find different results. On the one hand, manufacturing firms have quite similar results to the total sample, that is, internal R&D ($p < 0.01$), suppliers ($p < 0.01$), competitors ($p < 0.01$), conferences ($p < 0.01$) and publications ($p < 0.05$) positively affect the development of process innovation in companies. According to the marginal effects, if the rest of the variables remain constant, a 1% increase in R&D activities leads to an increase of 0.101 percentage points in the likelihood of developing a process innovation ($p < 0.05$). Consequently, the results in Table 5 support H1a, H2b, H2c, H4c and H4d, and are consistent with previous studies that show R&D (e.g., Becheikh et al., 2006), suppliers (e.g., Vaillant et al., 2021), competitors (Leiponen, 2005), conferences (e.g., Escribano et al., 2009) and publications (Heredia-Pérez et al., 2019) have positive effects on the development of process innovation in manufacturing companies.

On the other hand, in KIBS firms (33% of KIBS developed process innovation), internal R&D ($p < 0.1$), competitors ($p < 0.05$), and publications ($p < 0.05$) positively affect the development of process innovations. According to marginal effects, if the rest of the variables remain constant, a 1% increase in R&D activities leads to an increase of 0.122 percentage points in the likelihood of developing a process innovation ($p < 0.1$). Consequently, the results in Table 5 support H1b, H2c, and H4d, and are consistent with previous studies that show R&D activities (e.g., Pina & Tether, 2016), competitors (Leiponen, 2005) and publications (Chichkanov et al. 2021) have positive effects on the development of process innovation in KIBS. In addition, it can be seen that intellectual property activities are positively associated with all these relationships in KIBS firms.

Lastly, all this evidence confirms that there are differences in manufacturing and KIBS industries in terms of the relationships between the use of sources of information and innovation outcomes. Moreover, we find that in relative terms manufacturing firms have a greater positive effect on the relationship between the use of sources of information and innovation outcomes than KIBS do. Therefore, these results support hypothesis H5. Table 6 presents a summary of the validation of the hypotheses.

Conclusions

Theoretical Implications

This study provides two contributions. The first contribution is presenting evidence that internal R&D activities play a fairly relevant role in the achievement of

Table 5 Process Innovation Regression Models

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
Internal R&D	0.4869***	0.1125***	0.4464**	0.1011**	0.6216*	0.1224*
	0.1571	0.0357	0.1861	0.0416	0.3394	0.0656
Customers	−0.1014*	−0.0234*	−0.1336*	−0.0303*	0.0929	0.0183
	0.0583	0.0134	0.0703	0.0158	0.1187	0.0233
Suppliers	0.1646***	0.0380***	0.2610***	0.0591***	−0.0640	−0.0126
	0.0560	0.0128	0.0669	0.0146	0.1197	0.0236
Competitors	0.1814***	0.0419***	0.1508**	0.0342**	0.2590**	0.0510**
	0.0623	0.0142	0.0743	0.0167	0.1290	0.0248
Universities	−0.0936	−0.0216	−0.0658	−0.0149	−0.0851	−0.0168
	0.0884	0.0204	0.1060	0.0240	0.1776	0.0349
Business Associations	−0.1015	−0.0235	−0.0885	−0.0201	−0.2193	−0.0432
	0.0868	0.0200	0.1028	0.0233	0.1878	0.0367
Consultants	−0.0180	−0.0042	0.0260	0.0059	−0.1955	−0.0385
	0.07380	0.0171	0.0861	0.0195	0.1642	0.0321
Conferences	0.1940***	0.0448***	0.1674**	0.0379**	0.2061	0.0406
	0.0644	0.0147	0.0752	0.0168	0.1427	0.0278
Publications in Journals	0.1833**	0.0424**	0.1747**	0.0396**	0.3080**	0.0607**
	0.0727	0.0166	0.0860	0.0193	0.1528	0.0294
Intellectual Property Activities	0.2178	0.0503	−0.0973	−0.0220	1.0566**	0.2082***
	0.1896	0.0437	0.2171	0.0492	0.4195	0.0796
log(Size)	−0.0090	−0.0021	0.0049	0.0011	−0.0969	−0.0191
	0.0422	0.0097	0.0522	0.0118	0.0822	0.0161

Table 5 (continued)

	Total Sample		Manufacturer		KIBS	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
log(Age)	0.1031	0.0238	−0.1103	−0.0250	0.1177	0.0232
	0.0952	0.0220	0.1163	0.0263	0.2146	0.0422
(Intercept)	−0.9545***		−0.1691		−1.4162**	
	0.2876		0.3519		0.6350	
Observations	1141		830		311	
Pseudo R^2	0.0556		0.0530		0.0905	
Log-Likelihood	−746.54559		−534.83033		−180.2565	
Area under ROC	0.6577		0.6582		0.6949	
Wald Chi^2 ($Prob>Chi^2$)	0.0000***		0.0000***		0.0003***	
Hosmer-Lemeshow (Prob > chi2)	0.6457		0.4119		0.5495	

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

innovation outcomes in Peruvian companies, despite the fact that a small proportion of companies (28% of manufacturers and 18% of KIBS) carry out these activities. Internal R&D is mainly oriented at developing products (goods) in manufacturing firms, but also in KIBS firms. In fact, this study highlights the role of R&D in innovation outcomes in KIBS firms, especially when it comes to developing service innovations. Thus, this study helps to bridge the gap in the literature on this matter in the context of a Latin American country. On the other hand, we find that internal R&D is the main determinant of innovation outcomes, as it shows a stronger statistically significant positive effect than other, external sources of information, in both manufacturing and KIBS firms. Therefore, internal R&D is key to understanding Peruvian firms' innovation capacity (e.g., Heredia-Pérez et al., 2019; Seclen-Luna & Alvarez, 2021), and could also be an element enabling competitive differentiation.

The second contribution of this study is that it enriches the literature on the role of external sources of information in achieving innovation outcomes in Peruvian companies, despite the fact that the use of external sources of information by these companies is not widespread. First at all, we argue that firms endowed with more innovation capacity (e.g., R&D) are better equipped to identify the presence of external knowledge flows. Therefore, these internal capabilities can be complemented by external sources of information (e.g., Anzola-Román et al., 2018; Párida et al., 2012). For example, internal R&D may be complemented with information from customers and consultants in order to develop product (goods) innovation in manufacturing firms, while for KIBS firms, internal R&D may be complemented with information from competitors and conferences to achieve product (goods) innovation. Likewise, for KIBS firms, internal R&D may be complemented with information from customers to implement service innovation. As a consequence, to ensure that the new information is suitable for firms' own purposes and that external information can be used in existing processes and products, firms are likely to depend on their own R&D (Audretsch & Belitski, 2022). Secondly, the fact that companies consider the use of an external source important in order to generate innovations does not guarantee that it will have a positive effect on all types of innovations. For example, a large proportion of the companies in the sample use suppliers (70%) as a source of information to implement innovations; however, suppliers only have positive effects on process innovation in manufacturing companies. Therefore, it is clear what kind of innovation is most important to Peruvian manufacturing firms. In fact, there are several sources that manufacturing firms have used to implement process innovation. Although different sources of information can be associated with different innovation outcomes (e.g., Amara & Landry, 2005), in relative terms, Peruvian companies prefer to link to supply chain sources than other specialized and institutional sources, as found in previous studies (e.g., Del Carpio-Gallegos & Seclen-Luna, 2022; Heredia-Pérez et al., 2019). In addition, although this is not a central objective of the research, it is noteworthy that the role of universities is still limited and there may be difficulties in transferring knowledge to the production system (e.g., ECLAC, 2022). Therefore, further analysis is needed to corroborate these arguments.

Lastly, if our analysis had focused only on the total sample, we would not have been able to identify the differences between the industries analysed, as described in Table 6. Therefore, the cross-industry analysis has been instructive. In relative

Table 6 Summary of the validation of the hypotheses

Sources of Information	Innovation Outcomes		
	Total Sample	Manufacturer	KIBS
H1: There is a positive relationship between internal R&D and innovation outcomes of companies	Product & Process	Product & Process	Product, Service, Process
H2a: There is a positive relationship between the use of customer and innovation outcomes of companies	Service	Product & Service	Service
H2b: There is a positive relationship between the use of suppliers and innovation outcomes of companies	Process	Process	
H2c: There is a positive relationship between the use of competitors and innovation outcomes of companies	Process	Process	Product & Process
H3: Universities do not positively influence the innovation outcomes of companies in the context of a LA country	Product, Service & Process		
H4a: There is a positive relationship between the use of business associations and innovation outcomes of companies		Service	
H4b: There is a positive relationship between the use of consultants and innovation outcomes of companies	Service	Product & Service	
H4c: There is a positive relationship between the use of conferences and innovation outcomes of companies	Product & Process	Process	Product
H4d: There is a positive relationship between the use of publications and innovation outcomes of companies	Process	Process	Process
H5: Manufacturing firms have a greater positive effect on the relationship between the use of sources of information and innovation outcomes than KIBS firms		Yes	

terms, we find that manufacturing companies have a greater positive effect on the relationship between the use of information sources and innovation outcomes than KIBS firms do. However, there are certain nuances that suggest we should take this result with caution. Control variables show that the size and age of the companies does not influence these relationships; however, intellectual property activities do have a positive effect, mainly for obtaining product (goods) innovation (both for manufacturing and for KIBS firms). Thus, the study adds to the debate about innovation in these two different industries, based on evidence from a sample of 1141 Peruvian firms, comprising 830 manufacturers and 311 KIBS firms.

Managerial and Policy Implications

Firstly, since internal R&D is the main source used to achieve innovation outcomes, managers should boost R&D investment and seek complementarities with external information sources. Likewise, because there are several external sources of information that have a positive association with innovation outcomes (product, service and process innovation), managers should consider proper management of the company's external relations in their innovation portfolio. Thus, innovation management should include activities aimed at planning, organizing, managing and monitoring internal and external resources in order to innovate in a effective way. Secondly, this study could be of interest to universities for at least two reasons: the results could encourage the development of research projects aimed at gaining a better understanding of these relationships and their effects; and universities should seek to raise the visibility of the efforts they make to transfer knowledge to society and the production system, perhaps by using more effective indicators and properly managing the process. Finally, our findings may be of interest to policymakers in their efforts to promote and develop the innovation ecosystem, highlighting the need to foster interrelationships between the actors in the innovation system (companies, research centres, universities, etc.) and thereby generating opportunities for the development of innovations. Also, based on our findings, policymakers could consider designing instruments to support business innovation that involves sectoral or thematic priorities (e.g., ECLAC, 2022).

Limitations and Future Research

First, because the pseudo R2 values calculated for the probabilistic models are quite low, indicating relatively poor goodness of fit, findings should be taken with some caution. Nevertheless, in our case, the overall significance of the estimated models is established at 1% (Prob > chi2 = 0.000), indicating that the variables fit the models well. Second, due to the small number of observations for the variables of the study, we restrict the analysis to the industrial level, that is, manufacturers and KIBS industries. Thus, interpretations can only be made at the level of manufacturers (or KIBS) as a whole and not by categories of industrial activity. Third, this study is cross-sectional in nature and therefore does not capture the dynamics of the innovative process nor the collaboration process, where there are more complementary variables. Accordingly, future research should involve longitudinal studies which can identify relationships between external sources of knowledge and innovation outcomes and firm performance. Future studies could even consider an integrated solution approach (servitization and productization). Lastly, the fact that the dataset comes from a national innovation survey of a single country opens up the possibility of conducting comparative research between Latin American countries.

Funding Funding for open access publishing: Universidad de Granada/CBUA.

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