The effects of innovation on the decisions of exporting and/or importing in SMEs: empirical evidence in the case of Spain

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Abstract This paper analyses the involvement of small firms in international trade activities by identifying the comprehensive impact of innovation. Specifically, we study how innovation introduced by these firms determines the entrepreneurial decision-making process regarding whether to engage in exporting and/or importing. Our results confirm the interrelation of firms' exporting and importing decisions and consequently, these two decisions should be jointly estimated when analysing the influence incurred by the introduction of alternative types of innovation (product, process, and organizational/managerial innovation) on said decisions. Furthermore, findings show complementarity between types of innovation to be relevant in explaining export and import decisions made by SMEs. Specifically, cumulative effects as a result of combining product and process innovation, as well as of product, process and organizational innovation, are highly significant in explaining export decisions, while in the case of imports, the combination of product and organizational innovation is shown to be significant. These findings lead to major policy and managerial implications regarding the promotion of SMEs' participation in international trade flows through alternative innovation strategies.

1 Introduction

Globalization has engendered a knowledge-intensive economy (Teagarden and Schotter 2013), which pushes firms to explore external markets in order to expand and survive (Brenes 2000). In this context, SMEs have begun to play a critical role in overseas trade flows (i.e., export and import) and represent an important proportion of value added in international trade in most developed and industrialized countries (OECD 2017). The growing integration of SMEs in global value chains (GVCs) is explained by their increasing participation in international trade flows, in both imports and exports (Montalbano et al. 2018). The drivers behind SMEs' decisions to engage in international trade have attracted increasing interest among scholars and decision-makers in recent decades (Golovko and Valentini 2011; Hollenstein 2005; Paul et al. 2017). Empirical studies show that SMEs involved in international trade (as exporters, importers, or both) are able to grow faster than their domestic counterparts (Griffith et al. 2006; Bernard et al. 2007; Wagner 2012). Nevertheless, advances in studying the internal and external factors that

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may explain why firms export and/or import remain scarce (Kasahara and Lapham 2013). Among these factors, innovation seems to play a significant role since innovative SMEs are expected to initiate export and/or import activities due to the competitive advantages acquired by innovating (Cassiman et al. 2010; Damijan and Kostevc 2015; Di Cintio et al. 2017; Love et al. 2016; Kasahara and Lapham 2013; Pickernell et al. 2016). Nevertheless, the role that innovation (both technological and non-technological) plays in explaining internal decisions to initiate export and/or import activities still presents contradictory and inconclusive findings (Martineau and Pastoriza 2016; Pla-Barber and Alegre 2007).

Additionally, the literature that analyses the relationship between international trade participation and innovation decisions presents several significant gaps. The usual findings within this literature include the existence of a significant and positive link between innovation and participation in international trade (mainly in the form of exports), especially among larger firms (Roper and Love 2002; Zhao and Li 1997; Bernard et al. 2009). Most of these studies focus on examining the case of large manufacturing firms (Bernard and Jensen 2001; Roper et al. 2006), thus not considering other important sectors, such as services. In the case of smaller firms, evidence is not as concluding as for large firms, and no consensus has yet been reached regarding the explanatory factors behind the decision of SMEs to participate in international trade flows and the role played by alternative types of innovation in this process (Love and Roper 2015). Furthermore, most of the existing literature on SMEs focuses on their export performance (in line with outward internationalization theories), thus devoting much less attention to the link between innovation and import decisions. Nevertheless, several studies have highlighted that both export and import activities are interconnected due to the increasing role played by SMEs in GVCs and the existence of export and import productivity premia (Holmlund et al. 2007; Castellani et al. 2010; Halilem et al. 2014). In this respect, studies, such as those by Damijan and Kostevc (2015) and Feng et al. (2016), argue the existence of a robust interrelation between export, import, and innovation decisions among SMEs.

The analysis carried out in this research attempts to act as a nexus between the literature on international entrepreneurship, the SME exporting (outward trade) literature, and inward internationalization studies. International entrepreneurship theory presents the manager (or entrepreneur) as a key factor to explain business performance and decisions within SMEs. In this respect, evidence shows that managers of SMEs are the most relevant decision-makers in their businesses (Van Gills 2005), thus they significantly determine the firm's strategic decisions, such as initiate international trade activities (Foreman-Peck 2013; O'Regan and Sims 2008). Our study uses a survey where the managers of SMEs are the principal decision-makers, and thereby determine the firms' innovative and international profile. Additionally, the determinant role played by the entrepreneur is also embedded in the literature on outward (export) and inward (import) orientation of SMEs, since export and/or import decisions are usually influenced by the manager or entrepreneur (Martineau and Pastoriza 2016).

Another relevant gap emerges from the innovation types considered in the existing literature. Most studies focus on the connexion between technological innovation (i.e., product and process innovation) and decisions to participate in international trade (mainly export), and fail to consider the potentially significant role played by innovation of a non-technological nature (e.g., organizational innovation) and the complementarity and cumulative effects between these types of innovation to explain both export and/or import decisions (Becker and Egger 2013; Lewandowska et al. 2016).

This paper addresses the aforementioned gaps by empirically analysing how innovation (both technological and non-technological) determine the decision of SMEs regarding whether to get involved in foreign trade by exporting (final goods) and/or importing (intermediate goods or inputs). Moreover, the complementarity among alternative innovation outcomes (product, process, and organizational innovation) are tested in the potentially interrelated decision to export and/or import. Therefore, this study contributes to the recent literature that seeks to provide empirical evidence on the determinants of SMEs' involvement in international trade activities (both export and import) using firm-level data, by identifying the comprehensive impact of innovation on SMEs' export/import decisions (among other relevant factors). These findings would be of interest for decision makers since they provide information on how various types of innovation explain the participation of SMEs in international trade flows.

Furthermore, our results suggest that import and export decisions should be analysed as (potentially) interrelated decisions.

With this aim in mind, the contribution of this research to the scarce empirical evidence is twofold. Firstly, it covers the whole private sector of the Spanish economy with a wide sample of small firms in the manufacturing, service, and construction sectors that responded to a comprehensive questionnaire. Secondly, the study is constructed on a multidimensional analysis, which accounts for complementarity links between alternative types of innovation (i.e., technical and non-technical) and SME decisions on participation in international trade flows (i.e., exporting and/or importing), and also takes other major determinants into account, such as characteristics of the entrepreneur and a set of business strategic variables, as moderating variables.

The remainder of this paper is organized as follows. We start with a literature review about the association between innovation and participation of SMEs in international trade activities, followed by the proposed research hypotheses. The subsequent section presents the methodology applied in this study with a description of the dataset employed and the econometric method applied to test the research hypotheses. Section 4 presents the results, while in the final section we offer a brief discussion and some conclusions.

2 Literature review and research hypotheses

The decision of SMEs to participate in international trade and its relation with innovation has received significant academic attention from alternative theoretical frameworks in the last decade. However, the factors that explain why SMEs decide to get involved in international trade activities remain insufficiently explored, thus reflecting a significant gap in the literature (Halilem et al. 2014; Martineau and Pastoriza 2016). In this respect, international trade theories at the firm level, such as Posner's technology-gap (Posner 1961) and Vernon's product life-cycle (Vernon 1966) approaches, have been used to show how innovation constitutes a key source of competitive advantage, thus facilitating export performance (Roper and Love 2002). Along these lines, the literature on SME exporting has empirically confirmed this relationship by connecting the success of SMEs in foreign markets through their innovation capabilities (Autio et al. 2000;

Cassiman et al. 2010; Esteve-Pérez and Rodríguez 2013; Fernández-Mesa and Alegre 2015; Ripolles Melia et al. 2010). Furthermore, studies such as that by Golovko and Valentini (2011), emphasize that firms' innovation capabilities are a prerequisite for export success. Alternatively, studies based on resource-based theories have generally suggested that innovation capabilities become valuable resources for the firm to become successfully involved in international trade as exporters (Lopez Rodríguez and García Rodríguez 2005; Pla-Barber and Alegre 2007). Nevertheless, it is worth pointing out that despite the growing literature analysing the relationship between innovation and export decisions (see Roberts and Tybout 1997; Esteve-Pérez and Rodríguez 2013; Love and Mansury 2009; Love and Roper 2015; among others), the controversy surrounding the direction of causality remains unsettled, thereby leaving this as an issue of debate that requires further research (Añón Higón and Driffield 2011).[1]

In contrast to the great interest devoted to the study of the link between innovation and the involvement of SMEs in export activities, studies analysing the impacts of innovation on inward trade (or import participation) remain scant (Damijan and Kostevc 2015; Halilem et al. 2014; Kasahara and Lapham 2013). Bøler et al. (2012) find that innovating SMEs are usually involved in import activities in Norway, while Amiti and Khandelwal (2013) argue that innovators enjoy higher shares of imports in total sales. Similarly, Alvarez and Robertson (2004) and Almeida and Fernandes (2008) analyse this relationship for a set of companies in developing countries and conclude that previous innovation by the firm facilitates the assimilation of imported inputs and cooperation with external providers. Along these lines, Halilem et al. (2014) and Hessels (2007) find evidence that process innovation positively influences SMEs' decisions to import. Finally, Damijan and Kostevc (2015) find that process innovation improves the likelihood of importing and/or exporting compared to non-innovating firms. Conversely, these authors find no significant effects in the case of product innovation. In contrast to these studies, Hashmi (2013) argues that no significant relation seems to exist between innovation (of any type) and import activities

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[1] Models based on product-life-cycle approaches usually consider that innovation implementation causes export decisions. However, we have to bear in mind that exports may also incentivize innovation activities as predicted by endogenous growth trade models (Añón Higón and Driffield 2011).

within SMEs. Therefore, further research on this issue is necessary to understand the link between import and innovation decisions, while considering both technological and non-technological innovations.

This study analyses the SME's decision to participate in international trade as described by inward (import) and/or outward (export) involvement activities, and considers that these decisions (exporting and importing) might be related and jointly affected by the innovative orientation of the firm. Studies, such as those by Welch and Luostarinen (1988), Melitz (2003) and Kasahara and Lapham (2013), show that decisions by enterprises to import intermediate goods and to export final goods are interrelated based on productivity links, since imports may act as a significant trigger of competitive advantages (mainly through cost reduction or increase of product quality or variety). Other studies consider import involvement as a prerequisite to export initiation since the firm's capacity to import is influenced by its innovative profile (Damijan et al. 2010; Hessels 2007). Holmlund et al. (2007) and Aristei et al. (2012) show that importing fosters exporting within SMEs through the accumulation of new knowledge and the creation of innovative capabilities. Additionally, certain studies argue that these links between inward and outward internationalization activities (import and export), as well as the existing cross-learning process, are more likely to occur in smaller firms, since the manager is usually responsible for both decisions (Crick and Jones 2000; Damijan and Kostevc 2015; Halilem et al. 2014).

Despite these efforts, further research is needed for the analysis of how export and/or import decisions within SMEs might be jointly affected by alternative types of innovation (Becker and Egger 2013; Halilem et al. 2014; Lewandowska et al. 2016). Although evidence shows that export and import decisions are interrelated (Melitz 2003; Kasahara and Lapham 2013), few studies have addressed the potential relationship between these decisions and their links with the implementation of alternative innovations (i.e. technical and non-technical) by the firm, which constitutes a significant gap in the related literature (Love and Roper 2015; Seker 2011). In this respect, most studies analysing the role of innovation on the decision by SMEs to get involved in international trade flows have generally focused on innovations of a technological nature, such as product and process innovation. These studies are therefore extended since both technological and non-technological innovation are incorporated into our

analysis. In particular, we distinguish between three different innovation outputs: product, process and organizational (or managerial) innovation. In the survey employed, the three types of innovation follow the definition provided by the Organisation for Economic Cooperation and Development (OECD 2010: 55): "the implementation of a new or significantly improved product (good or service), or process, or a new organisational method in business practices, workplace organisation or external relations". Following Freeman (1974), technological innovations generate new (or significantly transformed) products and/or services in the firm's portfolio, as well as new processes in the firm's production activities. However, organizational innovation has a non-technological nature, since it refers to organizational changes and the introduction of new business practices.[2] Differentiation among innovation types is justified as their effects on the firm's strategic decisions (e.g. whether to export and/or to import) depend on the type of innovation considered (Freel and Robson 2004; Rosenbusch et al. 2011; Wolff and Pett 2006).

Regarding the participation of SMEs in international trade activities, the dominant view centres the analysis on the innovation in new products and technologies (or processes) as relevant explanatory factors (see Becker and Egger 2013; Cassiman and Golovko 2011; Love and Mansury 2009, among others). In this regard, studies such as those by Dosi et al. (2015), Lamotte and Colovic (2013) and Oke et al. (2007) argue that the impact of product innovation on SMEs' export decisions is significantly higher than that of process innovation. Specifically, and following Cassiman et al. (2010), these studies conclude that the greater impact of product innovation is explained by the superior quality of products and/or services provided by the firm, thereby dominating the first phases of the product life cycle. In the case of Spain, Caldera (2010) confirms this conclusion using a panel of manufacturing SMEs from Spain. Similarly, Cassiman et al. (2010) and Love and Mansury (2009) find that the firms' propensity to export increases with product innovation and not with process innovation. Other studies, such as that by Lim et al. (2006), argue that new product innovation acts as a requirement for export involvement, while Becker and Egger (2013)

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[2] Similar classifications can be found in other studies, such as Huiban and Bouhsina (1998), Madrid-Guijarro et al. (2013) and Expósito and Sanchis-Llopis (2018).

and Lopez Rodríguez and García Rodríguez (2005) find that both innovation types significantly stimulate firms to participate in international trade flows, thus suggesting the superiority of technical innovations (i.e. product and process innovation) in determining the firms' export and/or import decisions (Di Maria and Ganau 2013; Añón Higón and Driffield 2011). Nevertheless, empirical evidence on the relationship between innovation and import decisions in SMEs remains scant and non-conclusive (Damijan and Kostevc 2015; Halilem et al. 2014; Hashmi 2013; Kasahara and Lapham 2013).

Following the literature reviewed, we formulate the following research hypotheses:

> H1. SMEs that implement product innovation are more likely to engage in international trade activities.

> H1.1. Previous product innovation increases the likelihood of exporting abroad.
> H1.2. Previous product innovation increases the probability of importing inputs or intermediate goods from abroad.

> H2. SMEs that implement process innovation are more likely to participate in international trade.

> H2.1. Implementing process innovation raises the likelihood of exporting abroad.
> H2.2. Implementing process innovation increases the probability of importing inputs or intermediate goods from abroad.

Several studies have shown evidence about the complementarity between alternative types of innovation outcomes. In this respect, Doran (2012) finds that firms may combine product and process innovation to achieve competitive advantages both in internal and external markets. Other studies also suggest that firms implementing both product and process innovation enjoy a higher probability to initiate international trade activities (Becker and Egger 2013; Lamotte and Colovic 2013; Lewandowska et al. 2016; Lopez Rodríguez and García Rodríguez 2005). Therefore, it seems there might be an increasing effect, that is, a firm that introduces both process and product innovation is more likely to participate in international trade, as compared to firms introducing only one of these activities. Hence, Hypothesis 3 can be framed as follows:

> H3. SMEs that jointly implement product and process (technological) innovation are more likely to become involved in international trade activities.

> H3.1. Previous product and process innovation raises the probability of exporting abroad.
> H3.2. Previous product and process innovation increases the likelihood of importing inputs or intermediate goods from abroad.

Notwithstanding, the aforementioned studies do not contemplate the effect of non-technical innovation (i.e., organizational innovation), which we believe may play a significant role, both by itself and in complementarity with technical innovation (i.e., product and process innovation). In fact, undertaking technical and non-technical innovation may lead to cumulative beneficial effects in the decision to export and/or import (Lewandowska et al. 2016). Since non-technological innovation is usually related to the promotion of productivity increases and cost reductions, then these innovations are associated with the exploitation of cost-based advantages, instead of differentiation advantages (i.e. product and process innovation). Although most of the studies conducted in developed economies have focused on the effects of product and process innovation, in the case of developing economies, non-technical innovation and its associated performance gains have been identified as crucial determinants of firms' international involvement (Damijan et al. 2010; Prange and Pinho 2017). In the specific case of SMEs, this is relevant since SMEs usually lack the necessary resources (R&D, financial and human resources) to successfully develop technological innovation (e.g. new products and services). Moreover, the introduction of non-technical innovation may be easier for SMEs since this implies lower costs related to outcome failures and financial risks (Laforet 2013; Sok and O'Cass 2011). In the light of the literature review, we formulate the following research hypothesis:

> H4. SMEs that apply organisational innovation are more likely to start international trade activities.

> H4.1. Previous organisational innovation increases the probability of exporting abroad.
> H4.2. Previous organisational innovation raises the likelihood of importing inputs or intermediate goods from abroad.

Despite the empirical evidence suggesting the complementarity of different types of innovation, very little research exists on complementarities between technological and non-technological innovations in the context of the involvement of SMEs in international trade (Lewandowska et al. 2016; Navarro-García 2016). Organisational innovation has attracted much less attention within the literature; recent studies argue, however, that this type of innovation might become crucial in the deployment of resources and in their transformation into innovative products and processes, and hence, according to Hypotheses 1, 2 and 3, it affects the decisions by SMEs on whether to participate in international trade (Azar and Ciabushi 2016; Prange and Pinho 2017). Therefore, we believe that analysing the complementarity between different innovation outcomes (i.e. technical and non-technical) is relevant in explaining the export and import decisions taken by SMEs, since non-technical innovation may sustain technological innovation (Azar and Ciabushi 2016; Camisón and Villar-López 2011) through the necessary changes in the administrative and organisational systems required by the international activities (Lam 2005). The cumulative effects may therefore be determinant to explain export and import decisions within SMEs. Accordingly, the following hypothesis is formulated:

> H5. SMEs that implement both technological and non-technological innovations (i.e. product and/or process innovation, and organizational innovation) have a higher propensity to participate in international trade activities.
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> H5.1. Preceding development of technological and non-technological innovation raises the likelihood of exporting abroad.
> H5.2. Previous implementation of technological and non-technological innovation fosters the probability of importing inputs or intermediate goods from abroad.

Finally, it should be emphasised that internationalisation decisions by SMEs (i.e. export and/or import activities) might also be affected by other internal factors (different from innovation), such as the features of the firm, as well as by external factors, such as the characteristics of the sector (Navarro-García 2016; Ribau et al. 2017). Following the existing literature focused on the participation of SMEs in international trade, we also include several internal and external factors in our analysis as control or moderating variables in order to offer results of a more robust nature. A brief description and justification of these factors are provided in the subsequent section and in the Appendix.

3 Data

The data employed herein originates from a survey on the business performance and innovation capabilities of Spanish SMEs in 2012. All sampled firms have 250 employees or fewer and a turnover below 50 million Euros. The surveyed sample comes from six Spanish regions, which represented 41% of Spanish SMEs in 2012.[3]

The survey incorporated questions about the innovative activities carried out by the firm during the 3 years previous to the survey (period 2009–2011), as well as about other strategic decisions and characteristics of the firm, such as participation in international trade flows (i.e. export and import). As discussed previously, innovation constitutes a key factor in the decision by SMEs to internationalise. Therefore, we have hypothesised that, among other firm and sector characteristics, the implementation of product, process and/or organisational innovation by the firm would determine the decision to export and/or import. In relation to the internationalisation variables (either exporting and/or importing), the questionnaire asked managers whether the firm exports final goods and/or services to foreign markets (Export) and whether the firm imports inputs or intermediate goods from foreign providers (Import) to be incorporated into the production process. These two variables are dummy yes/no variables.

Regarding the innovation variables, the approach adopted in this study bases on self-reported information given by the entrepreneur. Several studies suggest that self-reporting constitutes an adequate approach for the analysis of a company's behaviour and decisions,

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[3] The surveyed regions were Andalusia, Basque Country, Estremadura, Comunidad de Madrid, Murcia and Navarre. According to the criteria of the Central Directory of Firms of the Spanish Statistics Institute, the surveyed population was stratified in terms of size and productive sector. A 20.8% response rate was achieved and no bias between respondents and non-respondents was detected.

especially regarding innovation (Hall et al. 2009; Foreman-Peck 2013; Madrid-Guijarro et al. 2013; Roper et al. 2008).[4] In relation to the questions on innovation, the questionnaire asked managers if any new or significantly improved innovation (product, process and/or organizational) has been introduced or developed during the period 2009–2011. Three yes/no dummy variables were constructed based on the answers given by the surveyed entrepreneurs/managers.[5]

A set of control variables have been considered in this analysis: characteristics of the firm, characteristics of the manager/entrepreneur, business management variables and external factors.

In relation to the firm's characteristics, the age and size of the firm are considered. These variables have received a great deal of attention as the firms' determinants in explaining SME participation in international trade (see, for example, Love et al. 2016; Roper and Love 2002). Nevertheless, most of the studies provide inconclusive results (Pla-Barber and Alegre 2007; Rutherford et al. 2001).

Entrepreneurial features constitute a second group of control variables, since SMEs' managers play a relevant role in this type of firms (Dobbs and Hamilton 2007). In fact, SMEs' entrepreneurs usually tend to either assume the main management functions or significantly influence strategic business decisions, including involvement in international activities. Consequently, the influence of these individuals and their characteristics are seen to exert a major impact on strategic management decisions, such as those regarding the introduction of innovations and the participation in international trade flows (Entrialgo 2002; Love et al. 2016). Within this group of variables, the age of the manager and/or entrepreneur, his/her education level and his/her entrepreneurial experience are considered key factors in understanding the reasons for a firm's strategic decisions (Storey 1994). A complete set of these variables are accounted for in this analysis.

Regarding other business management variables, a third group of control variables has been incorporated. Within this group, one relevant feature is the attitude of managers towards undertaking projects of high risk (and high expected returns) as compared to low-risk projects. Managers characterised by an appetite for risk are more likely to promote international trade activities in their businesses. Several research studies have found that SMEs involved in export and/or import activities register a high predisposition to carry out risky businesses and/or take risky decisions (Acs et al. 1997; O'Regan et al. 2005). Furthermore, a clear entrepreneur vision concerning the role that the engagement in high-risk projects plays in internationalisation processes is widely regarded as being beneficial for the establishment of international trade relationships between the firm and foreign suppliers and clients (Acs et al. 1997; Lamotte and Colovic 2013). In our case, a measure of the manager/entrepreneur predisposition towards carrying out risky projects (with a significant expected return) is introduced as a control variable. We believe that this variable might provide a significant determinant as regards engaging in international activities since such activities are considered to be risky strategic decisions.

Similarly, firms that engage in open innovation initiatives (e.g. research and development cooperation with external agents) might have greater opportunities for involvement in international trade, both by exporting and/or importing. Research and development collaborative relationships with market agents (e.g. providers, competitors) and institutional partners (e.g. public research institutes) may reduce the risks associated risks to innovation activities (Chesbrough 2006; Martínez-Roman and Romero 2017), whereby SMEs present good examples where cooperation on R&D can be extremely beneficial in terms of business performance (including successful involvement in international trade activities) (Kleinknecht and Reijnen 1992; Lee et al. 2010). Along these same lines, Paul et al. (2017) and Spithoven et al. (2013) assert that innovation collaboration initiatives constitute a powerful leverage to promote export and import activities within SMEs. Despite the various collaboration modes proposed in the literature (Chesbrough 2006), our analysis considers a limited definition of a collaborative

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[4] Empirical evidence shows that manager perceptions about implemented innovation outputs are highly correlated with alternative innovation indicators (Frishammar and Hörte 2005; Zahra and Covin 1993).

[5] As regards the use of binary variables, many recent studies, such as those by Dosi et al. (2015), Halilem et al. (2014), Kasahara and Lapham (2013) and Ribau et al. (2017), among others, use these types of variables to account for business decisions (e.g., international trade participation and innovation). As shown by the distribution of these binary variables as reported in Table 1, we believe that the analysed sample sufficiently captures the relevant information (Dosi et al. 2015).

relationship as that established with domestic institutional (e.g. public universities and research centres) and/or business (e.g. providers, competitors) partners, and it does not take into account complex modes of innovation cooperation, such as inter-firm alliances. Additionally, the analysis includes whether the business takes part in exhibition fairs, which can be understood as an attempt to expand business opportunities and also to build collaborative networks with clients and providers from abroad (Evers and Knight 2008).

Finally, several variables are also introduced in order to capture a wide variety of external factors that can influence decisions in SMEs. Many studies define environment, in terms of the industry sector, as the main external factor in explaining business decisions, such as those regarding exporting and importing (Gao et al. 2010). In fact, existing literature suggests that sectoral variables play a significant role, since service firms tend to export/import less than do manufacturing companies. In this regard, regional and sectoral dummy variables have been taken into account in our analysis to capture the influence of external factors. All variables used in our analysis are described in detail in the Appendix.

In what follows, Tables 1 and 2 report some descriptive statistics for the main variables of interest. Table 1 presents the number and proportion of firms that export and/or import. The frequency distribution is also provided in terms of the type of innovation developed by firms in our sample. As shown, 19.30% (25.26%) of the firms in the sample are exporters (importers). However, these percentages are higher, both in terms of exporting and importing, for those firms that introduce product, process or organisational innovation. This suggests that these innovation decisions are positively related to the firm's trade strategies. The distribution of the SMEs of our sample (Table 2) closely follows the distribution by sector and size at national level as registered by the Spanish Ministry of Industry, Energy and Tourism (2013).

Table 1 Number of observations and frequency by type of trader

	N	%	% Product innovators	% Process innovators	% Organizational innovators
Exporter	275	19.30	22.15	26.49	22.84
Importer	360	25.26	30.13	29.95	28.23

Table 2 Frequency distribution of certain categorical variables

Sector	%
Manufacturing	10.81
Real estate & construction	14.88
Commercial	25.61
Services	48.70
Size	
Micro (1–9 employees)	87.93
Small (10–49 employees)	10.46
Medium (50–250 employees)	1.61

4 Estimation

In this section, first the empirical methodology used for the estimation of the interrelated decisions of exporting and/or importing is outlined, and certain issues related to the potential endogeneity of the innovation variables are discussed. The estimation results are subsequently presented.

4.1 Empirical specification

We contemplate that an SME will decide to export (and/or import) in year t when the profits associated with that decision plus the discounted expected upcoming revenues from exporting (and/or importing) in year t exceed the costs.[6] The seminal paper by Roberts and Tybout (1997) is followed to motivate the firm's decision to export,[7] and this paper is extended by Kasahara and Lapham (2013) for the decision to export and import. Furthermore, we also consider the model by Atkeson and Burstein (2010) that examines firms' decisions to export and innovate in a dynamic general equilibrium model, where a firm's product and process innovation constitutes major determinants of cost reduction. In this literature, our empirical model considers the joint probability of exporting and importing as determined by

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[6] Firms that plan to export and/or import need to assume certain costs even before starting (and/or carrying out) these activities. Therefore, in order to export, a firm needs to study foreign markets, create adequate distribution and promotion channels, and most probably adapt its production to meet the quality and safety standards of the new markets. Furthermore, the importation of intermediate inputs requires a search for the best provider or incurs an investment to obtain a wider variety of external inputs, higher quality inputs, or foreign technology incorporated in imported intermediate inputs (Bustos 2011).

[7] See also Campa (2004) and Máñez-Castillejo et al. (2008) for the case of Spain.

various types of innovation (product, process and organizational innovation, and their many combinations), thereby providing proxies of the capabilities of these firms to push their expected profits over costs. Furthermore, we also control for other characteristics of the firm, entrepreneurial characteristics, other business features and external factors (see Appendix).

We estimate the exporting and importing decisions by means of a methodology that enables the potential interrelation of these strategies since, in the case of SMEs, these activities may be interrelated. In fact, exporters interact with firms in foreign markets in order to incorporate better quality inputs, which consequently contributes towards making these firms more competitive. This in turn will encourage exporters to start importing these intermediary inputs. In relation to importers, the fact of having access to foreign intermediate inputs allows firms to improve their production, which can promote their exports (Damijan and Kostevc 2015).

The empirical model we use is a discrete choice model for the decisions of exporting and/or importing (bivariate choice model), in which the likelihood of each decision in year t is conditioned on a group of alternative types of innovations implemented by firm i in the last 3 years and a group of other explanatory variables:

$$Export_i = \begin{cases} 1 & if \quad \beta^E Innovation_i + \gamma^E X_i + r_i^E + s_i^E + \varepsilon_i^E \geq 0 \\ 0 & otherwise \end{cases}$$

$$Import_i = \begin{cases} 1 & if \quad \beta^I Innovation_i + \gamma^I X_i + r_i^I + s_i^I + \varepsilon_i^I \geq 0 \\ 0 & otherwise \end{cases}$$

where β identifies the effect of innovation-related strategies (product, process or organizational innovation, and their many combinations) on the decisions to export and/or import; X_i is a vector of firm and entrepreneur characteristics and business features; r_i is a vector of regional dummy variables and s_i is a vector of sector dummy variables. Finally, ε_i represents the error term.

Since we allow that the decisions to export and import might be related, and these are dummy variables, a bivariate probit specification is employed that jointly accounts for these decisions.[8] The

potential endogeneity of innovation implies that we estimate two specifications: one without accounting for endogeneity; and a second that accounts for that endogeneity by instrumenting the innovation variables. Roodman's (2011) *cmp* module is used to estimate both specifications.

4.2 Estimation results

The estimation results of our study are set out in Table 3. The coefficients of interest are those related to the innovation variables, as we aim to analyse the effect of alternative innovation outputs (product, process and organizational innovation and their many combinations) undertaken by firms in the last 3 years, on their decisions to export and import. Our framework is similar to the model by Halilem et al. (2014), where innovations determine future export and import activities.[9]

In the first specification estimated (columns 1 and 2 of Table 3), the potential problem of endogeneity of our innovation variables is ignored. This specification is estimated as a bivariate probit model where the two strategic decisions are allowed to be correlated.

In the second specification (columns 3 and 4), the firms' innovation variables (product, process and organizational innovation) are instrumented as a robustness check. An instrumental-variable (IV) bivariate probit specification is employed to account for the likely endogeneity of the alternative innovation variables considered to explain the decisions to export and import. In order to introduce these variables, three variables are constructed at the firm level that account for the proportion of businesses (in the same industrial sector and business-size group) that implement product, process or organizational innovation. In these three new variables, the value of the firm itself is not considered.[10] This instrumental procedure is performed by estimating, in terms of maximum likelihood, a scheme of five equations that contain the exporting and importing decisions, and three further equations in which the product, process, and organizational innovation variables are

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[8] It is worth noting that the specified models do not suppose that export and import decisions are necessarily interrelated, but allows all possible decision combinations in the sense that some firms' only export, some only import, and others decide to perform both activities.

[9] In our case, given that our innovation variables capture firms' innovation within the last 3 years, this allows to estimate the link between innovation and international activities, considering that innovation determines future participation in foreign markets.

[10] We consider these new variables to be good instruments as these are correlated with the innovation variables we use and have low correlation with the trade variables (i.e. export and import).

Table 3 Estimation results: the interrelated decision to export and import

	Non-IV model		IV model	
	Export	Import	Export	Import
Constant	−1.607	−2.443	−1.784**	−2.461**
	(0.855)	(0.856)	(0.856)	(0.858)
Innovation type				
Product innovation	0.079	0.167	0.132	0.147
	(0.113)	(0110)	(0.130)	(0.123)
Process innovation	0.255	0.329	0.464**	0.370*
	(0.195)	(0.207)	(0.201)	(0.215)
Organizational innovation	0.036	0.020	0.001	−0.006
	(0.162)	(0153)	(0.178)	(0.165)
Product and process innovation	0.217	0.232*	0.413***	0.250*
	(0.147)	(0.140)	(0.161)	(0.152)
Product and organizational innovation	0.128	0.475***	0.151	0.431***
	(0.153)	(0.145)	(0.172)	(0.165)
Process and organizational innovation	0.073	−0.039	0.244	−0.026
	(0.231)	(0.228)	(0.241)	(0.237)
Product, process, and organizational innovation	0.369***	0.279*	0.555***	0.285*
	(0.139)	(0.148)	(0.157)	(0.163)
Firm characteristics				
Size	0.428***	0.250**	0.408**	0.250**
	(0.115)	(0.123)	(0.116)	(0.123)
Firm's age	0.095	0.203***	0.100*	0.205***
	(0.062)	(0.062)	(0.062)	(0.062)
Business features				
R&D cooperation	0.238***	0.189**	0.241***	0.190**
	(0.089)	(0.089)	(0.088)	(0.089)
Attending business and exhibition fairs	0.036	0.413***	0.045	0.411**
	(0.092)	(0.099)	(0.092)	(0.099)
Predisposition to risk	0.253**	0.140	0.252**	0.139
	(0.118)	(0.119)	(0.159)	(0.119)
Entrepreneur characteristics				
Age	0.150	0.245	0.150	0.249
	(0.240)	(0.236)	(0.239)	(0.236)
Experience	−0.112	−0.066	−0.108	−0.066
	(0.071)	(0.072)	(0.070)	(0.071)
Education level	0.089	0.066	0.094	0.068
	(0.082)	(0.082)	(0.081)	(0.82)
Regional dummy variables	Yes	Yes	Yes	Yes
Sector dummy variables	Yes	Yes	Yes	Yes
	Log likelihood = −1297.001		Log likelihood = −1258.179	
	Number of firms = 1425		Number of firms = 1425	
	$\rho = 0.457$***		$\rho = 0.456$***	
	(s.e. = 0.046)		(s.e. = 0.046)	
	Test $\rho = 0$		Test $\rho = 0$	
	$X^2(1) = 71.90$		$X^2(1) = 71.57$	
	$\rho = 0.000$		$\rho = 0.000$	

Standard errors are in parentheses

*, ** and *** mean significant at 10%, 5% and 1%, respectively

regressed on a set of specific instruments. The correlation tests of the errors between the three innovation strategy equations and the export and import equations indicate that our estimations might suffer slightly from endogeneity problems.[11] The specification we use for further analysis is therefore the IV specification, since an endogeneity problem is found for the process innovation equation. This problem is common in this type of study, since the likelihood that firms will innovate may be influenced by the innovative environment in which they operate (Lamotte and Colovic 2013).

Before examining the results, it should be borne in mind that multi-collinearity problems might be present in models that include various innovation variables. Multi-collinearity tests show that the variance inflation factors for our explanatory variables are between 1.08 and 1.41, and hence multi-collinearity does not constitute a problem in our estimated models (Neter et al. 1990).

It should also be taken into account that the correlations between the export and import equations (coefficients ρ) are positive and statistically significant for each specification (Table 3). This confirms that exporting and importing decisions are related and hence it is convenient to jointly estimate both decisions when analysing the role that innovation plays therein. In order to evaluate the goodness-of-fit of our estimates, the probabilities of exporting and importing are predicted for each firm in the sample. A comparison of these predictions with the observed data yields 81.26% and 76.14% of correctly predicted export and import decisions, respectively.

As regards the estimation results (see columns 3 and 4 in Table 3), alternative types of innovation developed by firms are found to have differential impacts on export and import decisions within SMEs. The implementation of process innovation or the combination of product and process innovation has a positive and significant effect on both exporting and importing strategies. Thus, our research Hypotheses 2.1, 2.2, 3.1 and 3.2 are validated, while Hypotheses 1.1, 1.2, 4.1 and 4.2 are not validated since product and organizational innovations alone show no significant effect on export decisions nor on import decisions. Findings show that product innovation would need to be combined with process innovation

(Hypothesis 3.1) or with process and organizational innovations (Hypothesis 5.1) in order to influence a firm's decision on export involvement, which is in partial disagreement with Cassiman et al. (2010), Dosi et al. (2015), and Love and Mansury (2009), who all highlight the superiority of product innovation in determining a firm's involvement in exports, although these three studies fail to consider possible complementarities between technical and non-technical innovation (as discussed in Section 2). With respect to the import decision, combining product and process innovation as well as product and organisational innovation show significant effects, thereby offering support to Hypotheses 3.2 and 5.2. Our findings also show that the combination of process and organisational innovation has no significant effect on export and import decisions, which would confirm the low relevance of organizational innovation in explaining decisions by SMEs to become involved in international trade activities. In fact, organisational innovation affects these decisions only in combination with product innovation (in the case of import decision) or in combination with both product and process innovations (for both the decision to export and import). Finally, the combination of the three types of innovation has a positive and significant effect on both exporting and importing decisions, thereby confirming our Hypotheses 5.1 and 5.2.

Regarding the control variables incorporated in the estimation, the following findings are worth highlighting. With respect to firm characteristics, our findings reveal that larger firms (firms between 10 and 250 employees) have a greater propensity to export and import, since a positive and significant coefficient is attained for the size variable. Furthermore, age also affects positively and significantly the firm export and import decisions.

The firm's business variable R&D cooperation impacts positive and significantly on the export and import decisions. However, attending business and exhibition fairs seems to exert a positive and significant effect only on the decision to import. Furthermore, the higher the predisposition of the firm is to undertake high-risk projects (and expected high performance), the higher the propensity to export becomes, since this variable has a positive and significant impact on the decision to export, but incurs no effect on the decision to import.

In the set of variables of entrepreneur characteristics, the age, experience and education level of the entrepreneur are included. None of these three variables has a

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[11] For the export equation, the p values estimated for the tests are equal to 0.179, 0.001 and 0.749 for the product, process and managerial equations, respectively. The values of the same tests for the import equation are 0.797, 0.564 and 0.776, respectively.

significant effect on export and import decisions. Finally, in all estimations, we control for regional dummy variables and sector dummy variables, although their corresponding coefficients are not reported in Table 3.

Finally, to check the robustness of the findings, we have run our same regressions but have included only the innovation strategy variables as regressors. Very similar results to those presented in Table 4 are obtained. Therefore, the inclusion of further covariates to capture other variables (e.g. firm and entrepreneur characteristics, and business features and environment) reinforces our results. The sensitivity analyses show that the impacts of innovation on export/import decisions within our sample of SMEs are not affected by the incorporation of additional explanatory variables in the tested models.

5 Discussion and policy implications

These findings confirm the general hypothesis that SMEs involved in innovation are more likely to participate in international trade activities (export and/or import), although the type of innovation in which the firm is involved is determinant in explaining this relationship. In fact, exporting is more likely to occur when the firm introduces process innovation or both product and process innovation (similar to Becker and Egger 2013; Lopez Rodríguez and García Rodríguez 2005) or the three innovation outcomes altogether. Furthermore, importing is more likely to occur if the firm implements process innovation only, or both product and process innovation, or both product and organization innovation or all three together. These findings are in line with those of Bøler et al. (2012), Amiti and Khandelwal (2013), Kasahara and Lapham (2013) and Halilem et al. (2014), who highlight the significant role of innovation in explaining import decisions, although they only focus on product and process innovation and fail to consider the cumulative effects derived from the simultaneous implementation of both technological and non-technological innovation. Our results, despite being consistent with previous estimates in the literature, highlight the importance of the combination of different innovation outcomes (i.e. technological and non-technological) to explain the involvement of SMEs in international trade activities, since the cumulative effects of

innovation are crucial in explaining strategic trade decisions (i.e. export and/or import). Specifically, combining product and process innovation appears to positively influence a firm's propensity to export and import, as found by Damijan et al. (2010), Añón Higón and Driffield (2011), Becker and Egger (2013), and Halilem et al. (2014). Furthermore, the combination of technical and non-technical innovation (i.e. product and organizational innovation in the case of import, and all three types in both export and import) is revealed to be significant in explaining SMEs' decisions to participate in international trade flows (Lewandowska et al. 2016; Navarro-García 2016). The cumulative effects of this combination might explain this phenomenon, since organizational innovation may sustain technological innovation through the necessary changes in the organizational structures and business practices required to facilitate the decisions to export and/or import (Azar and Ciabushi 2016; Camisón and Villar-López 2011; Lam 2005).

Additionally, our results indicate that exporting and importing decisions are linked, although they are different activities, and hence it seems convenient to jointly estimate both decisions when analysing the impact of innovation. Similarly, studies, such as those by Castellani et al. (2010), Damijan and Kostevc (2015), Feng et al. (2016) and Halilem et al. (2014), discuss the need to consider export and import decisions simultaneously when analysing their potential determinants.

Our findings lead to relevant policy and managerial implications for SMEs, given that many of these companies in Spain (and also in other EU countries) do not participate in international trade flows, neither in the flow of exports nor in that of imports. Despite the major efforts made by public institutions to promote the involvement of SMEs in international trade, as well as to encourage them to become more innovative, the links between innovation and export and/or import decisions seem to require readjustment. In this respect, certain recommendations can be extracted from our findings. First, to encourage the involvement of SMEs in international trade activities, firms should implement a multidimensional approach to innovation by pursuing synergies and complementarities among different types of innovations, thereby benefitting from their cumulative effects. Second, a combination of product and process innovations, as well as product, process and

organizational innovations, appears to be the most suitable strategy for the promotion of SME participation in international trade flows. Third, other variables, such as size, the age of the firm and R&D cooperation with external agents, also exert positive impacts on SME participation in export and import activities (as similarly found in the existing literature). Furthermore, our results also show that exporting requires SMEs to have a low aversion to initiating risky projects, such as establishing connections with foreign suppliers and clients. Such managerial orientation gives SMEs the ability to start business relationships in foreign markets, thereby facilitating decision-making regarding export and/or import strategy. Moreover, SMEs that attend business and exhibition fairs are more likely to participate in import activities, since contact with other business partners may improve both their knowledge related to foreign providers and their access to better and/or cheaper intermediate inputs.

Our findings are relevant for public and private decision makers. On the public side, innovation and internationalisation policies focused on SMEs should be coordinated and integrated in order to create an appropriate environment for SME innovation, which in turn constitutes an essential factor in the firms' decisions regarding whether to participate in international trade activities. This integration should occur at national and supranational levels (e.g. at EU level). On the private side, managers should consider the convenience of discriminating between alternative innovation outputs (and their combinations) to monitor their successful involvement in international trade flows.

6 Concluding remarks

This paper aims to analyse the link between innovation within SMEs and their decision to engage in international trade flows (i.e. export and/or import). Specifically, we study how introducing technical (product and/or process) innovation and/or non-technical (organisational) innovation determines whether firms decide to engage in the interrelated international activities of exporting and/or importing. Moreover, the complementarity between alternative types of innovation (product, process, and organisational innovation) are considered when estimating the interrelated decision to export and/or import. This study makes two relevant contributions to the existing literature on SME internationalisation. First, we consider both exporting and importing, whereas most studies in this field focus solely on outward internationalisation. Second, we consider for non-technological innovation (e.g. organisational innovation) and the role played by the synergies and complementarities generated with technological innovations (e.g. product and process innovations) in explaining export and import decisions in SMEs.

This study shows that solely focusing on product and/or process innovation appears to remain an insufficient strategy for the promotion of SME participation in international trade. A better strategy consists of combining this focus with non-technical (organizational) innovation in order to benefit from the cumulative effects and complementarities derived from all these types of innovation, which, as shown by our results, might increase SME participation in export and import activities. In summary, depending on the policy and management objectives, effort should be focused on specific types of innovation (and their combinations) in an attempt to stimulate the participation of SMEs in international trade flows. These efforts should also be supplemented with other strategic initiatives to facilitate engagement in export and import flows, such as the participation in fairs and exhibitions, as well as the development of R&D cooperation with other business partners and institutions. Both these factors have been shown to be significant in explaining export and import decisions within SMEs. Nevertheless, decision makers should bear in mind that innovation has, once more, revealed a key factor towards facilitating the involvement of SMEs in international trade.

Finally, the reduced sample size of Spanish SMEs and the fact that we only have data on 1 year constitute a significant limitation of this study, since it only allows for a static model to be tested. However, the meticulous sampling process during data collection assures the robustness and the significance of the empirical analysis and the results obtained. The set of variables used in our analysis, such as the three types of innovation considered, the firm's and the entrepreneur's characteristics and the limited set of business variables, may constitute another limitation since other, more relevant variables

might have been omitted. Furthermore, our results are in line with those obtained with samples of SMEs in other countries, which reinforces our findings. Future work should expand on this research by including longer time periods in order to understand the dynamic effects of innovation on the SMEs' decision to participate in international trade.

Appendix A.

Table 4 Definition of the variables.

Variables	Definition
Trade decisions	
Export	Dummy variable coded 1 if the business exports abroad
Import	Dummy variable coded 1 if the business imports inputs or intermediate goods from abroad
Innovation decisions	
Product innovation	Whether the business had introduced any new or significantly improved product/service innovation within the last 3 years (coded 1)
Process innovation	Whether the business had introduced any new or significantly improved process innovation within the last 3 years (coded 1)
Organisational innovation	Whether the business had introduced any new or significantly improved organizational innovation within the last 3 years (coded 1)
Firm characteristics	
Size	Dummy variable coded 1 if the business belongs to size-bands: Micro (1 to 10 workers), Small (11 to 50 workers), or Medium-sized (50 to 249 workers)
Firm age	Years since the business was founded
Business features	
Attending fairs	Dummy variable coded 1 if the business participates in business and exhibition fairs
R&D Cooperation	Dummy variable coded 1 if the business cooperates actively with domestic business partners or public institutions in R&D
Predisposition to risk	Variable measuring the firm's predisposition towards undertaking high-risk projects (and expected high returns) against low-risk projects (=1 for lowest predisposition and 7 for highest)
Entrepreneur characteristics	
Age	Age of the entrepreneur
Experience	Years of managerial experience of the entrepreneur in the business
Level of education	Dummy variable coded 1 if the entrepreneur attained a certain level of studies (= 1 unqualified, = 2 primary schooling; = 3 secondary school qualifications; = 4 vocational training; =5 university degree or higher)
Business environment	
Region	Dummy variable coded 1 if the business is located in a particular region
Sector	Dummy variable coded 1 if the business operates in a particular sector

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