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Innovation and business performance for Spanish SMEs: New evidence from a multi-dimensional approach

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Abstract
This article examines the impact of product, process and organisational innovations on two alternative dimensions of business performance: finance and operations. Two indicators capture financial performance: sales increase and production cost reduction. Operational firm performance is captured by two alternative indicators: productive capacity augmentation and quality improvement of product/service provided by the firm. Using a wide-ranging sample of Spanish small- and medium-sized enterprises (SMEs), our findings highlight the significant impact of innovation upon both these dimensions of business performance, although they differ regarding the type of innovation and the performance indicator considered. Furthermore, our results indicate that the relationship between innovation choices in SMEs and business performance should be analysed from a multi-dimensional approach. These findings reveal significant implications for innovation policies and strategies for SMEs.

Keywords
business performance, innovation, multi-dimensional analysis, SME, Spain

Introduction

Innovation constitutes a crucial driver for business competitiveness, (Porter and Ketels, 2003) and firm performance (Lichtenthaler, 2016; Oh et al., 2015), particularly for small- and medium-sized enterprises (SMEs) (Love and Roper, 2015; Pett and Wolff, 2009). The literature analysing the relationship between innovation strategies and business performance is extensive (see, for

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example, Añón-Higón et al., 2015; Freel and Robson, 2004; Gunday et al., 2011; Hall, 2011; Hervas-Oliver et al., 2014; Love and Roper, 2015; Máñez et al., 2013, 2015; Nemlioglu and Mallick, 2017; Rochina-Barrachina et al., 2010; Van Auken et al., 2008; Zahra and George, 2002). However, for SMEs, there exist an array of studies reporting mixed and/or inconclusive findings (Freel and Robson, 2004; Rosenbusch et al., 2011; Sok et al., 2016; Terziovski, 2010; Vermeulen et al., 2005). On one hand, Freel and Robson (2004) and Terziovski (2010) claim that the lack of robust large-scale data surveys for SMEs, together with the scarce research in this field, may lie behind the inconclusive findings in the literature. On the other hand, it is suggested that inconclusive results may be due to the fact that innovation requires the combination of specific resources such as financial, technological and human capital, and specific organisational capabilities, which might constitute a significant constraint (Hashi and Stojcic, 2012; O'Cass and Sok, 2013; Sok et al., 2016). Therefore, further research is warranted given a lack of empirical evidence on the relationship between innovation and SME performance (OECD, 2010; Rosenbusch et al., 2011).

This article aims to contribute to this gap by providing new empirical evidence on the relationship between innovation and SME business performance using a multi-dimensional analytical approach. This approach is based on the postulation that different types of innovations introduced by the firm exert a distinctive impact on the various dimensions of business performance (Nemlioglu and Mallick, 2017; Rosenbusch et al., 2011; Wolff and Pett, 2006). Specifically, we check whether the strength of the innovation–performance relationship depends on the type of innovation and upon the performance dimension considered. Three different types of innovation are analysed: product, process and organisational (or managerial) innovation.[1] Product and process innovations are commonly related to technological innovation, since technological changes generate new or transformed products/services and processes (Freeman, 1974). Organisational innovation, however, is mainly based on changes introduced into the organisational and administrative structures of the firm. They are more closely related to management, rather than to the firm's, main activities (Camisón and Villar-López, 2014; Walker et al., 2015). Similar classifications can be found in Lichtenthaler (2016), Madrid-Guijarro et al. (2013) and Ramanadi et al. (2017).

In order to analyse the potential impacts of alternative innovation strategies on SME performance, a separate analysis is undertaken for the financial and operational performance dimensions, each of which is measured by two alternative indicators. This adds to the traditional measures based only on sales growth (Hervas-Oliver et al., 2014; Love and Roper, 2015). Two indicators capture the firm's financial dimension: sales increase and cost reduction, while for the operational dimension we use two alternative indicators: the increase of productive capacity and the improvement in the product/service quality. Although the impacts of product and process innovations on SME business performance indicators have been relatively well studied (Aragón-Sánchez and Sánchez-Marín, 2005; Hervas-Oliver et al., 2014; Prajogo et al., 2013), studies focused on the impact of organisational innovation remain scarce (Camisón and Villar-López, 2014; Nemlioglu and Mallick, 2017; Walker et al., 2015). Therefore, this article extends the scope of previous studies in this research field using a multi-dimensional approach that allows innovation to act differently on SMEs performance according to the type of innovation and/or the performance dimension considered. Our main contribution lies within the comprehensive innovation–performance analysis based upon empirical data; this not only shows the impact of innovation types on the performance of SMEs, but also clarifies how different innovation types distinctively influence alternative performance indicators. Finally, our findings point that the relationship between SMEs innovation choices and business performance should be analysed from a multifaceted approach.

For the empirical analysis, a sample of Spanish SMEs was drawn from industrial, construction, commercial and services sectors, collected in 2012, but with retrospective information on the three previous years for innovation activities. The main findings indicate that while only product and organisational innovations significantly influence financial performance measures, all innovation types (product, process and organisational) exert positive effects on the operational performance dimension when both indicators (i.e. increase in productive capacity and product/service quality improvement) are simultaneously considered. In this regard, our results help to uncover the extent to which innovation might help to improve certain performance dimensions of SMEs, which are central for entrepreneurs, policymakers and business agents.

The article is organised as follows. The next section reviews the main literature on the relationship between the innovation decisions and business performance of SMEs and presents our research hypotheses. The subsequent section presents information on the sample and on the methodology applied in the analysis of the data. The last two sections discuss the analytical results and present conclusions.

Literature review and hypotheses

SMEs are commonly defined as reactive, flexible and risky organisations (Terziovski, 2010), but are also generally more innovative than their larger competitors (Gupta et al., 2013). This reflects the widespread assumption that entrepreneurs and managers of small businesses need to innovate to successfully compete with larger established firms (Rosenbusch et al., 2011). The literature reveals positive effects of innovation activities on firm performance (Hervas-Oliver et al., 2014; Nemlioglu and Mallick, 2017; Sok et al., 2016). Most have focused on specific SME dimensions of business performance, mainly involving financial performance variables such as sales, financial profit and production costs or productivity (Nemlioglu and Mallick, 2017). These analyses do not adopt a multi-dimensional approach to account for several performance indicators, as proposed in this study. Furthermore, the literature on innovation fails to reveal any clear conclusions on whether a specific innovation type is more likely to exert an influence upon specific performance indicators, both financial and operational (Rosenbusch et al., 2011). In this vein, research such as that by Damanpour et al. (2009), Lichtenthaler (2016), Hervas-Oliver and Sempere-Ripoll (2015) and Wolff and Pett (2006) state that innovation should be addressed as a multifaceted phenomenon with different types of benefits for SME performance, depending on the type of innovation introduced. Thus, we aim to disentangle how these influences upon financial and operational dimensions of SME performance may differ between types of innovation.

Most studies have principally analysed the effects of technological innovations, such as product innovation and, to a lesser extent, process innovation, on SME performance (Foreman-Peck, 2013; Hervas-Oliver et al., 2014; Hervas-Oliver and Sempere-Ripoll, 2015). However, there remains a lack of knowledge regarding the impact of non-technological innovation, such as organisational innovation, upon performance (Aragón-Sánchez and Sánchez-Marín, 2005; Walker et al., 2015). In relation to this issue, Lin and Chen (2007) and Walker et al. (2015) argue that organisational innovation reveals itself to be a key factor for the improvement of SME performance. Focusing on the financial dimension of business performance, it has been noted that robust evidence illustrates the higher financial margins obtained by innovative SMEs. This indicates that innovation may foster sales growth and internal efficiency, thereby significantly reducing production costs due to the gains obtained from the increase in labour productivity (Añón-Higón et al., 2015; Foreman-Peck, 2013).

Hall et al. (2009) argue that product and process innovations exert a positive impact on SME productivity and production costs while Foreman-Peck (2013) finds that product and process

innovations positively influence SME financial turnover. In the case of Spanish SMEs, similar findings are uncovered in Añón-Higón et al. (2015) and Hervas-Oliver et al. (2014). Furthermore, the latter study includes organisational innovation, together with process innovation, as positive determinant factors of the financial performance of SMEs. In contrast, Jaumandreu and Mairesse (2016) show that although process innovation may reduce production costs, product innovation may lead to increased production costs. Reflecting such concerns, Freel and Robson (2004) and Hall (2011) argue that product and process innovations do not necessarily positively influence sales growth and productivity. Indeed, they assert that, based upon their analysis, such impacts are negative. Regarding organisational innovation, Lin and Chen (2007) argue that, the impact exerted by this type of innovation on SME sales increase is greater than that of technological innovations. Accordingly, Gunday et al. (2011) reveal the existence of a positive impact of organisational innovations, as well as product and process innovations, on SME sales and productivity performance. Therefore, it is evident that innovations improve the financial performance of SMEs. We contribute to this literature by studying the effects of different types of innovations on both firm sales and production costs.

In particular, we can propose that different types of innovations exert different influences upon both financial performance indicators (i.e. sales increase and reduction of production costs). Specifically, the following hypotheses are tested:

Hypothesis 1: The impact of innovation on SME financial performance differs depending on the type of innovation and the performance indicator considered:

1.a. Product innovation exerts, *ceteris paribus*, a positive impact on sales growth, but a negative impact on production cost reduction.

1.b. Process innovation exerts a positive impact on both performance indicators, other factors being constant.

1.c. Organisational innovation exerts a positive impact on both performance indicators, other factors being constant.

The impact of innovation on the operational dimension of SME business performance has attracted much less attention than the financial dimension. Among the few studies regarding the impact on the operational dimension, Prajogo et al. (2013) argue that innovation constitutes a determinant factor for the achievement of learning economies, thereby enhancing the firm's ability to set higher quality standards in the provided products and services. Similarly, studies such as that by López-Mielgo et al. (2009) and Saunila (2016b) point out that innovative firms possess greater capability to identify, assimilate and apply knowledge more easily throughout the firm. This advantage translates into the continuous improvement of both productive processes and product quality. Similarly, studies such as Edquist (2001) and Zahra and George (2002) show that the spread of innovation to processes and managerial aspects in multiple business areas of a firm might improve its productive potential and lead to a continuous improvement in quality. This in turn improves the competitive advantage of firms, which contributes to medium-term business survival. Reflecting such arguments, studies such as Scarbrough et al. (2015) and Prajogo et al. (2013) underline that process and organisational innovations may play a significant role in the improvement of product and service quality as a result of the introduction of new forms of management (e.g. total quality management) that enhance quality in certain areas or in the firm as a whole. Moreover, López-Mielgo et al. (2009) argue that process and organisational innovations exert a positive effect efforts

for total quality management. Based on the existing evidence, quality improvement of products/services can be a significant performance indicator, in an operational dimension, upon which all types of innovation exert a positive impact.

Other research has focused on analysing the impact of innovation on production growth and go beyond the simple sales or revenue growth indicator (Freel and Robson, 2004; Harrison et al., 2014; Triguero et al., 2014). Furthermore, growth in terms of the generation of employment has received particular attention through alternative measures (Harrison et al., 2014; Triguero et al., 2014). Specifically, Triguero et al. (2014) state that process innovation shows a positive effect on employment for Spanish SMEs, while that of product innovation remains insignificant. Conversely, Harrison et al. (2014) show the opposite results for a wider ranging sample of firms covering four European countries. We consider the increase of productive capacity as a global operational outcome, given that more production generally implies an increase in employment and physical capital used by the firm.

Based on a critical evaluation of the literature, we contribute by including the operational performance dimension through two alternative indicators: productive capacity augmentation and improvement of the quality of products/services provided by the firm. The following hypotheses are therefore tested:

Hypothesis 2: The operational performance indicators of SMEs are influenced differently depending on the type of innovation considered:

2.a. The quality of the products/services provided by the firm is, *ceteris paribus*, positively influenced by any type of innovation.

2.b. The augmentation of productive capacity is positively influenced by any type of innovation, other factors being constant.

As the main research hypotheses have been identified, it should be stressed that the impact of innovation on SME performance may be moderated by contextual factors, both internal and external to the firm (Foreman-Peck, 2013; Lichtenthaler, 2016; Rosenbusch et al., 2011). Among these moderating factors, the characteristics of a firm, such as size and age (Hall et al., 2009; Rochina-Barrachina et al., 2010), the features of the entrepreneur, such as educational level acquired and managerial experience (Dobbs and Hamilton, 2007; Saunila, 2016a), and entrepreneurial and strategy determinants (Lichtenthaler, 2016) have been revealed as major factors. R&D cooperation strategies both with market partners and with public agents among SMEs have also played a significant role in developing new products and processes (Spithoven et al., 2013). In addition, governance environmental, national or regional, cultural and sectoral characteristics have attracted attention as moderating factors in the innovation–performance relationship (Saunila, 2016a; Yang, 2017). On the basis of these arguments, our analysis controls for these internal and external variables in order to test the proposed research hypotheses.

Figure 1 illustrates the multi-dimensional conceptual framework and the variables considered in our analysis. This framework briefly proposes that the three different types of innovations implemented in SMEs may have an impact upon the two business performance dimensions, financial and operational. Nevertheless, these impacts differ depending on the type of innovation and the performance indicator considered. In addition, the innovation–performance relationship may be moderated by other internal and external factors. A detailed description of all variables is given in the following section, as in the Appendix 1.

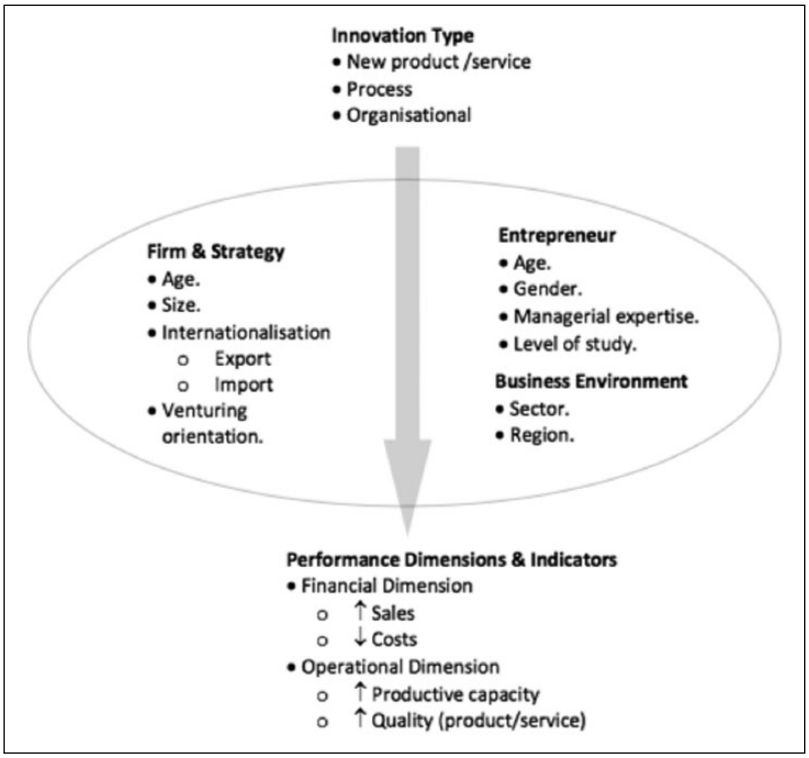

Figure 1. Multi-dimensional conceptual framework.

Methodology

Data and sampling method

The data are taken from a survey undertaken in 2012 on the competitiveness of Spanish SMEs; it includes firms with less than 250 employees and annual sales below €50 million.[2] This project received support from the Spanish Ministry of Economy, Industry and Competitiveness, as well as from several Spanish regional governmental agencies. The survey was conducted across six Spanish regions: Andalusia, Extremadura, Madrid, Murcia, Navarre and the Basque Country, representing the southern, central and northern regions of the country.

The questionnaire was designed to include questions on the innovative activities of each business and on the subjective perceptions of the entrepreneur regarding the impact of innovation, introduced by the firm during the three years previous to the year of the survey (period 2009–2011), and regarding the various dimensions of its current business performance. Data on the characteristics of the firm and those of the entrepreneur and on business strategies were also gathered. All types of SMEs were included in the study with the exception of self-employed entrepreneurs without employees. The survey was addressed to the person holding the role of entrepreneur in the firm, defined as the person who performs principal managerial functions within the business. In this regard, several studies have provided empirical evidence that SME managers undertake the most important decisions within their organisations (Van Gills, 2005), including those regarding innovation strategies, and their managerial perceptions shape the

firm's strategic behaviour to a significant degree (Alegrem et al., 2011; Donate and Sánchez de Pablo, 2015). In addition, several recent studies suggest that self-reported information by managers can be used as an adequate approach to measure business performance and other strategy variables, such as innovation (Foreman-Peck, 2013; Goya et al., 2016; Madrid-Guijarro et al., 2013; Ramanadi et al., 2017; Ribau et al., 2017).[3]

The sampling procedure was designed to represent the structure of the regions following the stratified sampling principles in finite populations. The population of firms was segmented by size, sector and location in order to ensure wide coverage. The number of firms in each stratum was calculated with reference to the information contained in the Central Directory of Firms, which had been collated by the Spanish National Statistical Institute. The stratified sample was representative of the business population of every region included in the study with quotas for business-size groups and sectors, with an error of ±6.0% at a confidence level of 95.5%. A response rate of 20.8% was obtained in the fieldwork. The final dataset, after correcting for missing data, was made up of 1424 observations. No bias was detected between respondents and non-respondents.

Variables

The research analysis proposed is constructed on the hypothesis that innovations (i.e. product/service, process and organisational innovations) introduced by the firm in previous years have a significant and positive effect on the various dimensions of business performance for SMEs in subsequent years. The business performance and innovation variables employed are described below. We also present a descriptive analysis for these variables. A more detailed description of the variables is provided in Appendix 1.

In order to measure SME business performance, we use the manager's perception on specific financial and operational indicators related to firm performance. Although these perceptions appear subjective, it should be emphasised manager perceptions have been used as a valid instrument when the source of the information guarantees data reliability.[4]

The questionnaire asked managers the following question: 'Is your firm *perceiving a significant beneficial impact on its business performance due to innovations introduced in the last three years?'*, for which the possible answer is either '*yes*' or '*no*'. In addition, the questionnaire distinguished between four alternative indicators regarding business performance gains: two indicators on a financial dimension (increase in sales and cost reduction) and another two on the operational dimension (increase in productive capacity and improvement in the quality of products/services provided by the firm).

As regards innovation variables, the survey provides information on three types: product (or service) innovation, process innovation and organisational innovation. The definition used in the survey for innovation indicates that the innovation is significantly new to the firm, and hence innovations of an incremental nature are not considered. The questionnaire asked managers the following question: *'Has your firm introduced any new or significantly improved innovation during the last three years?'*, where innovations are classified as *product/service innovation, process innovation, or organisational innovation.* If the firm has introduced any of the innovations mentioned, then the answer to the question is *yes*, and *no* otherwise.[5] Following Foreman-Peck (2013), self-reported information by the SME manager has been considered a valid non-biased source.

A number of control variables that have demonstrated explanatory relevance in the literature are also considered in our empirical analysis and are introduced as follows. These variables are grouped into four categories: characteristics of the firm, entrepreneurial characteristics, business strategies and determinants of the business environment.

As regards the characteristics of the firm, we consider age and size. These variables have received much attention in their role as a firm's determinants in explaining SME performance (Goya et al., 2016; Hall et al., 2009; Rosenbusch et al., 2011). It has been noted that smaller and younger firms tend to expand faster since they strive to achieve a minimum efficient scale and/or a minimum market presence in order to withstand competition (Coad et al., 2016; Dobbs and Hamilton, 2007). However, some studies have identified the same level of performance among firms with different size and age characteristics, leading to non-conclusive results (Rochina-Barrachina et al., 2010; Rutherford et al., 2001).

The second group of control variables are entrepreneurial factors. A distinguishing characteristic of SMEs is the special role played by the owners/founders, who normally tend to either be managers themselves or maintain a high level of control over business operations (Dobbs and Hamilton, 2007). Consequently, the performance of their business is highly influenced by their personal characteristics (Entrialgo, 2002; Saunila, 2016a). Variables, such as manager's age, level of education, prior entrepreneurial experience, and even gender, are considered critical to understanding a firm's performance (Koryak et al., 2015; Kraus et al., 2012; Martínez-Roman and Romero, 2017). Another relevant issue is that of the alternative attitudes of managers towards innovation and its associated risk. It is likely that a low level of innovation/risk aversion may help to distinguish between innovative and non-innovative firms. Managers characterised by innovation and with an appetite for risk promote innovation and ventures in their business in order to outperform counterparts (Kraus et al., 2012; Mayer-Haug et al., 2013). Nevertheless, other studies have shown only modest effects of manager characteristics on business performance (Anderson et al., 2014; Sayal and Banerjee, 2017). In our study, variables such as the entrepreneur's age, gender, business experience and education level are introduced as control variables.

In the third group of control variables, we include the business strategy variables. Many SMEs do not engage with internationalisation processes (Ribau et al., 2017). However, exporting and/or importing may be important characteristics of those firms that achieve better business performance (Love and Roper, 2015; Oura et al., 2016). An increase in sales volume due to exports and/or a higher productive capacity due to imported equipment and intermediate products may improve the performance of internationalised companies (Ramanadi et al., 2017; Ribau et al., 2017). Indeed, empirical evidence suggests that innovative SMEs are more likely to produce sales growth from trading internationally than non-innovative firms (Love and Roper, 2015). These variables are therefore considered in order to capture potential moderating effects of export/import activities in the relationship between innovation and business performance (Lee et al., 2012).

Another strategic issue is the firm's involvement in collaborative R&D initiatives. Collaborative relationships include networks and alliances with market competitors and public institutions and are created in order to innovate with a shared risk and provide greater opportunities for outperformance (Vásquez-Urriago et al., 2016). In this sense, evidence shows that open innovation initiatives are of great help in the promotion of better innovation and business performances for SMEs (Greco et al., 2015; Vahter et al., 2013). In our analysis, both types of collaborative relationships (public and within the market) are considered, as well as whether the firm participates in sectoral trade fairs, which can be interpreted as an initiative to promote both cooperation and internationalisation of the firm.

In addition, it has been found that successful SMEs tend to have innovation-friendly cultures, which are typically characterised by low levels of risk aversion and of resistance to change (see, among others, Alegrem et al., 2011; Sayal and Banerjee, 2017). In our case, a measure of the venturing orientation of the firm, as a measure of its level of aversion to carrying out risky innovation projects, is also introduced as a control variable.

Table 1. Number of observations and frequency by innovation type.

	N	%
Innovators	892	62.60
Innovators by type		
Product innovation	790	55.44
Process innovation	404	28.35
Organisational innovation	464	32.56

Finally, variables are also included that capture the business environment where the firm operates. There is a wide variety of contextual constraints and opportunities influencing SME performance (Autio et al., 2014; Buesa et al., 2010). The literature suggests that innovative activities differ significantly between sectors (Segarra-Blasco and Teruel, 2011). In this regard, certain studies rely on regional and industry dummies to capture differences in, for example, levels of technology between sectors, but also in the levels of industry and business regulations, policies and so on, between regions. Unfortunately, the survey collected no data on environment or regional incentives/barriers for innovation and hence, the influence of factors such as legal and financial barriers, and public support of innovative activities, cannot be separately controlled for. In this regard, only a set of regional and industry dummies is incorporated in the analysis.

Sample description

In Table 1, the descriptive statistics for the main variables are presented. In particular, we report the proportion and number of innovators and the frequency distribution for the type of innovations introduced by firms in our sample. It can be observed that 62.60% of the firms in the sample introduced at least one innovation in the period 2009–2011. However, the distribution of firms by type of innovation is as follows: 55% of the sampled firms have introduced new products or services, 28.35% have introduced process innovations and 32.56%, organisational innovations.

Table 2 provides further information on the composition of the sample regarding sector, size and firm-strategy variables. The average size in our sample is that of 9.5 employees and the average business age is 17 years (93% of businesses had been operating for at least five years at the time of the survey). The variable 'Venturing Orientation', which measures the risk aversion of the firm, averages 3.2 on a Likert-type scale ranging from 1 (lowest level of venturing and risky orientation) to 7 (highest level). Our average entrepreneur is 46 years old, male (69% of the sample), with a university degree or higher level of qualifications (49.5% of the sample) and 16 years of managerial experience.

Analytical methodology

In order to test the hypothesis described above, we estimate two bivariate specifications to analyse the impact of innovation on business performance: one accounting for the two financial performance indicators and another for the two operational performance indicators. This estimation method takes into account the potential simultaneity between the increase in sales and the reduction in costs (financial dimension) and the simultaneity between the increase in productive capacity and quality improvement (operational dimension).

Table 2. Frequency distribution of certain categorical variables.

Sector	%
Industry	10.81
Real estate and construction	14.88
Commercial	25.61
Services	48.70
Size	
Micro (1–9 employees)	87.93
Small (10–49 employees)	10.46
Medium (more than 49 employees)	1.61
Firm strategy	
Exporting	19.30
Importing	25.26
Trade fair	73.12
R&D market cooperation	23.79
R&D public cooperation	15.09

As stated in the literature, implementing a product, a process or an organisational innovation might have an impact on the firm's sales and/or on its costs. Likewise, for the case of the operational performance dimension, innovation might have an effect on the firm's productive capacity and/or on its quality. We therefore, acknowledge the existence of a potential correlation between each of the two indicators in both performance dimensions.

Thus, the bivariate specification model for the two financial performance measures is as follows

$$
\begin{aligned}
sales_i &= \begin{cases} 1 & if \quad \alpha_0^s + \beta_1^s prod_i + \beta_2^s proc_i + \beta_3^s org_i + \gamma_i^s X_{1,i} + \delta_1^s X_{2,i} + \theta_i^s X_{3,i} + \varepsilon_i^s \geq 0 \\ 0 & otherwise \end{cases} \\
\text{costs}_i &= \begin{cases} 1 & if \quad \alpha_0^{co} + \beta_1^{co} prod_i + \beta_2^{co} proc_i + \beta_3^{co} org_i + \gamma_i^{co} X_{1,i} + \delta_i^{co} X_{2,i} + \theta_i^{co} X_{3,i} + \varepsilon_i^{co} \geq 0 \\ 0 & otherwise \end{cases}
\end{aligned}
\tag{1}
$$

where subscripts *s* and *co* stand for sales and costs, respectively. The two dependent variables are *sales* and *costs*. The variable *sales* (*costs*) takes value 1 if the firm declares sales increases (costs reductions), and 0 otherwise. The variables *prod*, *proc*, and *org* capture whether firm *i* has introduced a product innovation, a process innovation, or an organisational innovation, respectively. We also introduce three sets of control variables: characteristics and strategies of firms $X_{1,i}$; entrepreneur characteristics $X_{2,i}$ and business environment variables $X_{3,i}$. Finally, ε_i is an error term.

Analogously, the bivariate specification model for the two operational performance measures is

$$capacity_i = \begin{cases} 1 & if \quad \alpha_0^{ca} + \beta_1^{ca} prod_i + \beta_2^{ca} proc_i + \beta_3^{ca} org_i + \gamma_i^{ca} X_{1,i} + \delta_1^{ca} X_{2,i} + \theta_i^{ca} X_{3,i} + \varepsilon_i^{ca} \geq 0 \\ 0 & otherwise \end{cases}$$

$$quality_i = \begin{cases} 1 & if \quad \alpha_0^{q} + \beta_1^{q} prod_i + \beta_2^{q} proc_i + \beta_3^{q} org_i + \gamma_i^{q} X_{1,i} + \delta_i^{q} X_{2,i} + \theta_i^{q} X_{3,i} + \varepsilon_i^{q} \geq 0 \\ 0 & otherwise \end{cases} \quad (2)$$

where subscripts *ca* and *q* stand for capacity and quality, respectively. The two dependent variables are *capacity* and *quality*. The variable *capacity* (*quality*) takes value 1 if the firm declares an increase in production capacity (quality improvement), and 0 otherwise. As before, we introduce three innovation variables: *prod, proc* and *org*. And three sets of control variables ($X_{1,i}$, $X_{2,i}$ and $X_{3,i}$).

The two equations capturing the financial performance indicators, specification 1, are jointly estimated to allow for the potential correlation between the two financial performance indicators. In addition, the two operational performance indicators, specification 2, are also jointly estimated to allow for the potential correlation between the two operational performance indicators. A test for this correlation is provided after the estimation of the two bivariate specifications.

A further issue we have to address is that of the potential endogeneity of the innovation covariates. Although the innovation variables are set via retrospective questions that refer to the three years prior to the sampling year, there might still be a problem of endogeneity largely because innovation and performance are both cumulative processes and there may be feedback loops between them over time. An instrumental variables approach is therefore implemented in order to account for this issue and a likelihood ratio test is provided for the endogeneity of the three innovation variables, given that our estimation procedure is based on maximum likelihood.[6] To instrument the innovation variables, the recommendations by Antonakis et al. (2010) are followed. In particular, we instrument each of the three innovation indicators using a sample-constructed variable: for each firm the propensity to implement an innovation by all firms in the same sector is calculated (without accounting by the firm itself). This approach is commonly used in the literature and the variable constructed is not suspected of endogeneity for a particular firm. Furthermore, the region in which the firm operates is also introduced as an instrument. The two proposed model specifications are estimated using Roodman's (2011) *cmp* module for the estimation of fully observed recursive mixed-process models.

Before examining the results, it is important to note that models that include various dimensions of innovation might be subject to multi-collinearity. A test for this multi-collinearity is therefore carried out on all our models. The variance inflation factors range from 1.02 to 2.06 for the explanatory variables in our tested models. Since these values are far below the cut-off point of 10, multicollinearity is ruled out (Neter et al., 1990).

Results

The results are presented in Tables 3 and 4, which show the performance dimension considered, financial and operational, respectively. In both the tables, the marginal effects are presented for our set of explanatory variables on four alternative outcomes: (1) the probability that neither of the

Table 3. Bivariate probit estimates for financial performance dimensions.

	(1)	(2)	(3)	(4)
Product innovation	−0.081***	0.054***	−0.039***	0.065***
	(0.021)	(0.019)	(0.014)	(0.021)
Process innovation	−0.046*	0.001	−0.000	0.045*
	(0.025)	(0.022)	(0.016)	(0.024)
Organisational innovation	−0.063***	−0.027	0.020**	0.070***
	(0.023)	(0.021)	(0.010)	(0.022)
Firm characteristics				
Size 2	−0.063*	−0.012	0.005	0.069*
	(0.032)	(0.031)	(0.023)	(0.037)
Size 3	−0.092	−0.066	0.047	0.111
	(0.072)	(0.066)	(0.066)	(0.092)
Age	−0.001	0.001	−0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Entrepreneur characteristics				
Gender	−0.046**	−0.014	0.011	0.050**
	(0.023)	(0.020)	(0.015)	(0.022)
Age	0.002*	0.000	−0.000	−0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Experience	0.001	0.003**	−0.002**	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Study level 2	0.137	0.062	−0.029	−0.169
	(0.089)	(0.094)	(0.077)	(0.122)
Study level 3	0.134	0.044	−0.017	−0.162
	(0.088)	(0.092)	(0.076)	(0.121)
Study level 4	0.117	0.049	−0.020	−0.146
	(0.088)	(0.093)	(0.077)	(0.122)
Study level 5	0.104	0.034	−0.009	−0.129
	(0.086)	(0.092)	(0.076)	(0.121)
Firm strategy				
Export	−0.067**	−0.007	0.005	0.068**
	(0.027)	(0.025)	(0.018)	(0.027)
Import	0.019	0.044	−0.032	−0.031
	(0.026)	(0.023)	(0.017)	(0.026)
Trade fair	−0.019	0.044**	−0.031**	0.007
	(0.024)	(0.021)	(0.016)	(0.023)
Market collaboration	−0.020	0.064***	−0.046***	0.037
	(0.027)	(0.024)	(0.018)	(0.027)
Public collaboration	−0.017	0.043	−0.031	0.005
	(0.032)	(0.029)	(0.021)	(0.032)
Venturing orientation	−0.030***	0.009*	−0.006*	0.027***
	(0.005)	(0.005)	(0.004)	(0.005)
Observations	1424			
Wald Chi^2	207.94***			
Pseudo R^2	0.057			
Correctly classified	41.15%			
Correlation between outcomes:	H_0: $\rho = 0$ $Chi^2 = 72.52$ p value = 0.000			
LR test for the instruments:	$Chi^2(7) = 5.42$ p value = 0.067			

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.
Robust standard errors are given in parentheses.

Table 4. Bivariate probit estimates for operational performance dimensions.

	(1)	(2)	(3)	(4)
Product innovation	−0.060***	−0.023	−0.006	0.089***
	(0.018)	(0.021)	(0.007)	(0.025)
Process innovation	−0.069***	−0.038	−0.004	0.110***
	(0.021)	(0.025)	(0.009)	(0.029)
Organisational innovation	−0.048**	−0.025	−0.003	0.076***
	(0.019)	(0.025)	(0.011)	(0.028)
Firm characteristics				
Size 2	0.018	−0.024	0.012	−0.006
	(0.029)	(0.033)	(0.013)	(0.041)
Size 3	−0.125**	−0.154*	−0.005	0.283***
	(0.040)	(0.066)	(0.042)	(0.089)
Age	−0.000	0.002*	−0.001**	−0.001
	(0.001)	(0.001)	(0.000)	(0.001)
Entrepreneur characteristics				
Gender	−0.035*	−0.002	−0.007	0.043*
	(0.018)	(0.022)	(0.007)	(0.026)
Age	0.003**	0.004***	−0.000	−0.006***
	(0.001)	(0.001)	(0.000)	(0.002)
Experience	−0.002	−0.001	−0.000	0.002
	(0.001)	(0.001)	(0.000)	(0.002)
Study level 2	−0.032	0.043	−0.023	0.011
	(0.082)	(0.094)	(0.045)	(0.124)
Study level 3	−0.005	0.078	−0.025	−0.048
	(0.081)	(0.094)	(0.045)	(0.122)
Study level 4	0.001	0.039	−0.014	−0.026
	(0.082)	(0.094)	(0.045)	(0.123)
Study level 5	0.019	0.052	−0.014	−0.057
	(0.081)	(0.093)	(0.045)	(0.122)
Firm strategy				
Export	−0.038*	−0.032	0.001	0.069*
	(0.023)	(0.027)	(0.009)	(0.032)
Import	0.016	0.007	0.001	−0.024
	(0.021)	(0.025)	(0.009)	(0.030)
Trade fair	−0.032*	0.001	−0.007	0.037
	(0.018)	(0.022)	(0.007)	(0.027)
Market collaboration	−0.037	−0.014	−0.004	0.054**
	(0.023)	(0.027)	(0.009)	(0.032)
Public collaboration	−0.027	0.049	−0.019	−0.003
	(0.028)	(0.033)	(0.012)	(0.038)
Venturing orientation	−0.021***	0.014***	−0.000	0.035***
	(0.004)	(0.005)	(0.002)	(0.006)
Observations	1424			
Wald Chi^2	222.61***			
Pseudo R^2	0.079			
Correctly classified	57.23%			
Correlation between outcomes:	H_0: $\rho = 0$ $Chi^2 = 163.66$ p value = 0.000			
LR test for the instruments:	$Chi^2 = 18.01$ p value = 0.001			

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.
Robust standard errors are given in parentheses.

performance indicators is influenced (column 1), (2) the probability that only the first indicator is influenced (i.e. sales increase in column 2 in Table 3, and productive capacity augmentation in column 2 in Table 4), (3) the probability that only the second indicator is influenced (i.e. cost reduction in column 3 in Table 3 and quality improvement in column 3 in Table 4) and (4) the probability that both performance indicators are simultaneously influenced (column 4).

Before discussing the results, we would like to stress that in both bivariate probits we report the test of correlation, H_0: $\rho = 0$, between the two indicators: the correlation between the increase of sales and costs reduction, for the financial performance indicator; and the correlation between the augmentation of productive capacity and the improvement in quality, for the operational indicator. In both the cases we reject the null hypothesis, which indicates that both the components in each performance indicator are correlated (see the results for this test at the bottom of each table). Furthermore, a specification LR test is also reported in order to check the validity of the instrumental variable estimates. In both the cases, we find that the innovation variables are endogenous and, therefore, the estimates where these innovation variables are instrumental are reported in the tables (the results for the LR tests are also reported at the bottom of each table).

As regards the financial dimension, Table 3 reports the estimated marginal effects from a bivariate probit specification as defined above (see equation (1)). Our findings show that introducing product innovation in the past three years reduces the probability of declaring that neither of the two financial performance indicators has improved (always under the *ceteris paribus* assumption) by 8.1% (see column 1 in Table 3). In contrast, this introduction increases the probability that both financial performances occur by 6.5% (see column 4). For the intermediate outcomes, introducing product innovation raises the expected probability of a sales increase by 5.4% (column 2), but reduces the probability of a cost reduction by 3.9% (column 3). This last result seems to be plausible since the development of new products may involve cost increases in the short term, as highlighted by Jaumandreu and Mairesse (2016). Hence, although product innovation implies a negative effect in terms of increasing production costs, the overall impact on the two financial indicators is positive (6.5% increase of the expected probability of outcome 4). Therefore, *Hypothesis* 1a is confirmed by our results.

As regards process innovations, our results show a more limited impact of this type of innovation on the financial performance indicators. Specifically, the introduction of process innovation reduces (increases) the probability of declaring that neither (both) of the two performance indicators occur by 4.6% (4.5%). No statistically significant effects are observed for intermediate outcomes (columns 2 and 3). Therefore, *Hypothesis* 1b is not fully supported by our findings. Finally, with respect to organisational innovation, the estimated marginal effects show statistically significant impacts both on the probability that neither of the performance indicators occur (a reduction of 6.3%), and on the probability that both occur (7% increase). In addition, organisational innovation has a significant effect on increasing the probability of a cost reduction (column 3) as shown by the estimated marginal effect. These results are in line with those of Gunday et al. (2011), Hervas-Oliver et al. (2014) and Lin and Chen (2007). Therefore, our results also confirm *Hypothesis* 1c.

There are several notable effects related to the control variables included in our specification. As shown by the estimated marginal effects, being a small SME (a firm with 10–50 employees) increases the probability of a positive outcome in both indicators and reduces the probability of declaring no effect on either indicator. Furthermore, the entrepreneur's gender and experience are significant in the determination of the probability that firms declare financial gains as a result of innovation. Among the strategic variables, exporting, participation in trade fairs, collaboration in innovation activities with market agents and venturing orientation appear to be of major importance in determining whether an SME registers a positive impact on financial performance or not, as shown by the statistically significant marginal effects reported in Table 3. Finally, it is worth

mentioning that the strong significance of the export orientation of the firm found in the results strengthens the idea of complementarity between innovation and exporting to enhance business performance.[7]

The results for the operational performance indicators can now be discussed. Table 4 shows the estimated marginal effects of explanatory variables on the expected probability that each of the four outcomes occurs. Our findings show that any type of innovation significantly reduces the expected probability that neither of the two indicators of business performance is influenced (column 1), and increases the expected probability that both indicators are positively influenced (see column 4). As regards the two intermediate outcomes (columns 2 and 3), the estimated marginal effects for our three innovation types are non-significant. These findings provide significant evidence that firm innovation constitutes an influential factor in determining business performance from an operational point of view, as also suggested by Hsueh and Tu (2004), López-Mielgo et al. (2009) and Zahra and George (2002). More specifically, our results reflect that any type of innovation, from new products to processes and organisational aspects, influence operational performance in SMEs, by enhancing their competitive advantages in the medium term through greater productive capacity and quality of the products/services offered in the market. However, we detect no impact of the innovations on any of the performance indicators taken separately (columns 2 and 3 in Table 4). Therefore, *Hypotheses* 2a and 2b can only be partially supported by our findings.

As regards our control variables, firm size and entrepreneur's gender and age register several significant effects. Again, collaboration in innovation with market agents appears to be a relevant factor for outcome 4, and the venturing orientation of the firm exerts a significant impact on several performance outcomes.

Based on the findings, innovation introduced by the firm exerts a distinctive impact upon the various dimensions of business performance. The strength of the innovation–performance relationship depends on the type of innovation and on the performance dimension considered, thereby answering the general research question discussed in the introduction of this article. Moreover, our findings confirm that the impact of innovation initiatives on business performance should be analysed from a multi-dimensional approach, as also suggested by other authors, such as Nemlioglu and Mallick (2017) and Wolff and Pett (2006), among others.

Conclusion

Implications of the results

The results suggest that innovations contribute towards the creation of value for the SME in terms of better business performance. Nevertheless, innovation asserts a wide range of effects on different performance dimensions. In this sense, results highlight the convenience of discriminating among innovation types and performance measures to guide innovation policies more efficiently. Therefore, we argue that the concept of business performance has different dimensions and that the effect of innovation can differ noticeably depending on the type of innovation and the performance dimension considered. Most of the attention given to the effects of innovation on business performance has focused upon the relationship between technological innovation (e.g. product innovation) and business growth measures (e.g. sales; Jaumandreu and Mairesse, 2016; Walker et al., 2015). The consideration of other performance dimensions (e.g. quality improvement) and non-technological innovations (e.g. organisational innovation) has traditionally been overlooked (Lichtenthaler, 2016). This article indicates that the relationship between innovation and business performance has to be analysed from a multi-dimensional analytical approach, since technical and non-technical innovations exert different impacts on alternative dimensions of the business performance of SMEs. In the

financial dimension, it is worth mentioning that product innovation causes a clear and significant positive impact on sales increase, while organisational innovation increases the probability that a cost reduction occurs. With respect to the operational performance dimension of SMEs, we find that all innovation types assert significant and positive impacts on both performance indicators. In addition, our findings suggest that innovation might operate as a booster of the competitive advantage of SMEs that are seeking to expand their productive capacity, as size also appears to be a relevant factor towards enjoying better operational performance, and improves the quality of products and services offered by the firm.

Innovation can therefore be characterised as a multifaceted phenomenon that has different types of potential performance benefits. Our results illustrate that it is important to distinguish between the types of innovation given the diverse effects of innovation on firm performance; certain innovations are more beneficial than others. Our findings reflect those of Damanpour et al. (2009), Freel and Robson (2004), Nemlioglu and Mallick (2017), Rosenbusch et al. (2011) and Wolff and Pett (2006), although the scope of the multi-dimensional analysis undertaken in this study, with respect to innovation types and performance outcomes, is more ambitious.

These findings are worthy of note as they improve the comprehension of an SME's relationship between innovation and business performance through the recognition of the multi-dimensional impacts of innovation upon business performance. In addition, this evidence has implications for policymakers and managers as the aid to the design of more effective innovation strategies aimed at achieving specific business outcomes. In particular, many firms overlook the positive effects of different types of innovation, usually focusing only on technological innovations. Yet, organisational innovation has a significant impact particularly with regard to the operational dimension of business performance. Thus, the limited attention afforded to non-technological innovation might miss opportunities to improve business performance. Further, non-technological innovations do not necessarily require extensive investment; this offers opportunities for firms with limited funds or scarce options to develop effective innovation projects.

It is critical for business managers to focus upon an appropriate innovation strategy as benefits from alternative types of innovation differ, depending on the dimension considered, to achieve the desired financial and/or operational outcomes. Similarly, decision makers engaged in the design of innovation policies should consider the innovation–business performance relationship from a multi-dimensional approach, particularly when public funding resources are limited. Thus, determining where to place priority becomes an issue of importance to secure returns on innovation efforts.

Limitations and future research

We are conscious that our study contains certain limitations related to the limited sample of Spanish SMEs. However, the thoroughness of the sampling process guarantees representativeness, which supports our empirical research hypotheses. Furthermore, our results reflect those of other countries, which reinforce the validity of our findings. Future research should be expanded to cover more time periods, thereby improving the understanding of the dynamic relationship between innovation and business performance for Spanish SMEs. In addition, the analysis of complementarity relations between innovation strategies in a multi-dimensional innovation–performance framework would also be desirable.

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Notes

1. Following the definition of the Organisation for Economic Cooperation and Development (OECD), this study distinguishes between three types of innovation: product, process and managerial/organisational. The definition by the OECD is: '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' (OECD, 2010: 55).
2. We acknowledge that the age of the data set might represent a limitation. However, the composition of Spanish small- and medium-sized enterprises (SMEs), both by sector and innovativeness orientation, has not changed significantly in the last years.
3. Our data are comparable to the Community Innovation Survey, where all information relies on self-reporting responses by managers. Nevertheless, it should be noted that several studies, such as those by Henley et al. (2006), March and Sutton (1997) and Rong and Wilkinson (2011), discuss the drawbacks that self-reported information by managers may imply in adequately assessing business outcomes and causality relationship. Despite this potential subjectivity, the perception of firm's respondents on innovation highlights the involvement of individuals in the innovation process (Torchia et al., 2011).
4. Several studies have found that manager perceptions regarding innovation introduced by the firm are highly correlated with objective measures of innovation, such as patents and R&D expenses (Frishammar and Hörte, 2005). Thus, following Foreman-Peck (2013) and Madrid- Guijarro et al., 2013), this study has considered that self-reporting responses are a valid method for the identification of innovation initiatives among SMEs.
5. Since we only know whether an innovation occurred or not, the innovation variables used herein fail to capture the magnitude of innovation. This constitutes a limitation of our measures, although it is slightly counterbalanced by the fact that the question asks for novel or significantly improved innovations.
6. Hausman and LR tests are two specification tests that are equivalent, see Qian (1999).
7. In this regard, certain studies argue that higher sales growth in SMEs can be achieved when innovation and export activities take place simultaneously. Along these lines, studies such as those by Añón-Higón and Driffield (2011), Di Cintio et al. (2017), Golovko and Valentini (2011) and Máñez et al. (2015) offer interesting findings.

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Appendix 1. Definition of the variables.

Variable	Definition
Business performance	
Sales increase	Whether the business has increased sales due to innovation introduced within the last three years (coded 1)
Cost reduction	Whether the business has reduced costs due to innovation introduced within the last three years (coded 1)
Productive capacity	Whether the business has increased productive capacity due to innovation introduced within the last three years (coded 1)
Quality improvement	Whether the business has increased quality due to innovation introduced within the last three years (coded 1)
Innovation	
Product innovation	Whether the business has introduced any new or significantly improved product/service innovation within the last three years (coded 1)
Process innovation	Whether the business has introduced any new or significantly improved process innovation within the last three years (coded 1)
Managerial innovation	Whether the business has introduced any new or significantly improved managerial innovation within the last three years (coded 1)
Firm characteristics	
Size	Dummy variable coded 1 if the business belongs to size-bands: 1 = micro (1–10 workers), 2 = small (11–49 workers) or 3 = medium-sized (50–249 workers).
Age	Years since the business was founded
Entrepreneur characteristics	
Gender	Dummy variable coded 1 if the entrepreneur is male (= 0 if female)
Age	Age of the entrepreneur
Experience	Years of managerial experience of the entrepreneur in the business
Level of study	Dummy coded variables indicating the entrepreneur's level of studies (1 = unqualified, 2 = primary schooling, 3 = secondary school qualifications, 4 = vocational training and 5 = university degree or higher)
Business strategy	
Export	Dummy variable coded 1 if the business exports abroad
Import	Dummy variable coded 1 if the business imports from abroad
Trade fair	Dummy variable coded 1 if the business participates in trade fairs
Market collaboration	Dummy variable coded 1 if the business cooperates actively with business partners in R&D
Public collaboration	Dummy variable coded 1 if the business cooperates actively with public institutions in R&D
Venturing orientation	Variable measuring the venturing orientation of the firm (= 1 for highest risk aversion to enrolling in risky business projects, and = 7 for lowest risk aversion)