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Influence of task-related diversity of R&D employees on the development of organisational innovations: a gender perspective

Adrian Testera Fuertes and Liliana Herrera
Departamento de Dirección y Economía de la Empresa, Unversidad de León, León, España

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Abstract

Purpose – This paper aims to analyse the influence of workforce diversity on the firm's likelihood to develop organisational innovations. Operationalising human resources diversity is not straightforward, and its effect has been rather overlooked in the context of non-technological innovations. This study analyses the impact of task-related diversity among research and development (R&D) unit workers and women R&D workers, in particular.

Design/methodology/approach – To estimate the impact of task-related diversity on firm propensity to undertake organisational innovation, this study uses a generalised linear model (GLM) – with a binomial family and log–log extension. GLMs are used to control problems of over-dispersion, which, in models with binary response variables, could generate inaccurate standard error estimates and provide inconsistent results.

Findings – This paper provides three important results. Firstly, employee diversity increases the firm's propensity to engage in organisational innovations. Secondly, the influence of each facet of task-related diversity varies depending on the type of organisational innovation considered. Thirdly, gender has an effect on the innovation process; this study shows that women play a different role in the production of non-technological innovations.

Originality/value – This paper makes several contributions to the literature. Firstly, it makes a theoretical contribution to research on innovation management by considering the influence of human resources diversity on the development of non-technological innovations. Secondly, this study analyses the role of workforce diversity in an R&D department context to clarify the contribution made by women R&D workers.

Keywords Organisational innovation, Management innovations, Workforce diversity, R&D, Innovation

Paper type Research paper

1. Introduction

Organisational innovation has attracted significant academic interest due to its critical role in driving business success and competitiveness in today's rapidly changing markets. It includes new management practices, workplace organisation and communication systems, which offer a plethora of opportunities to study interdisciplinary collaboration. Analysis of organisational innovation has led to a large and growing literature on its underlying facilitating mechanisms, factors and strategies.

Although the literature has identified contextual and corporate determinants of organisational innovation (O'Brien, 2020), individual determinants have received less attention (Damanpour, 2020). This represents a significant gap because the introduction of change and

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implementation of organisational innovation depend heavily on firms' individual employees (Romero-Martínez *et al.*, 2017). The limited empirical evidence on individual factors focuses on variables such as employee age, length of time in the firm and specialisation, but provides no clear conclusions. For instance, some studies associate older age and longer tenure in the firm with an aversion to change and risk (Quazi and Talukder, 2011), lower levels of creativity and less interest in organisational innovation (Binnewies *et al.*, 2008). Others associate these same variables with greater knowledge and experience and a positive relationship to organisational change (Damanpour and Schneider, 2006; Liu *et al.*, 2016).

In the absence of definitive evidence on the impact of individual factors, this study adopts a workforce diversity lens to determine how various employee attributes influence the firm's propensity for organisational innovation. This focus on workforce diversity is justified on at least two theoretical grounds. Firstly, the well-known resource-based view posits that workforce variety brings to the firm a range of skills, experience and perspectives, potentially enhancing its capacity for innovation (Basheer *et al.*, 2021; Wang *et al.*, 2017). Secondly, the concept of absorptive capacity (Cohen and Levinthal, 1990) suggests that a diverse workforce increases the firm's ability to recognise, assimilate and apply new knowledge, which leads to more innovation (Teixeira *et al.*, 2021). This would suggest that workforce diversity influences the type of information available during the innovation process and may be critical for introducing organisational change at various firm levels.

Although the literature provides evidence of a link between workforce diversity and firm innovation activity, it is less clear about how this relationship emerges in the context of non-technological innovations such as organisational innovations. The literature is also ambiguous on the impact of workforce diversity on organisational change. It has been suggested that it provides the firm with a broader range of information, knowledge, skills and expertise, which enhances its decision-making and development of innovations (Dahlin *et al.*, 2005; Wei and Wu, 2013). However, it has also been proposed that workforce diversity can have negative effects on employees' abilities to generate innovation, by reducing cohesion among employees or slowing the decision-making process (García-Martínez *et al.*, 2017; Georgakakis *et al.*, 2017).

This paper aims to contribute through an analysis that focuses particularly on task-related diversity among employees and the intersectionality of gender. Examining task-related attributes allows us to determine whether diverse education and functional experience of employees enhance the firm's ability to engage in the complex task of developing organisational change. Unlike other employee attributes, education and functional experience are related closely to the firm's structure and social processes. Therefore, task-related diversity could be crucial for enhancing creativity and problem-solving, encouraging cross-functional collaboration and facilitating knowledge transfer and learning (Ali *et al.*, 2021).

We add to this debate by proposing a gender perspective, because gender is another source of workforce diversity. The reasons for our choice are, firstly, that previous research shows that gender diversity can have both positive and negative effects on innovation. On the one hand, men and women embrace different perspectives and can contribute different experience and problem-solving approaches, which can lead to more innovative ideas (Post and Byron, 2015). On the other hand, gender diversity can be the cause of communication barriers and conflicts that can hinder innovation (González-Moreno *et al.*, 2018). Therefore, it is important to determine under what conditions these effects emerge. Secondly, traditional approaches to the analysis of the impact of gender diversity do not provide clear evidence on the roles of men and women in the innovation process. Diversity research tends to focus only on whether a certain balance between women and men workers fosters innovation activity and ignores the impact of diversity among subgroups of employees. For example, research on the role of women in innovation activities that takes no account of the differences within groups of women cannot provide accurate conclusions (van Knippenberg and Schippers, 2007).

We introduce the intersectionality of gender in the analysis of these relationships to offer a more nuanced understanding of the dynamics at play. In the context of task-related diversity, it is essential to recognise that an individual's experience, expertise and perspectives are shaped not only by his/her education and functional backgrounds but also by his/her intersecting social identities. Use of an intersectionality lens allows a better understanding of how gender might influence the innovative potential of a diverse workforce.

We examine how workforce diversity and gender intersectionality affect three kinds of organisational innovations: internal function innovations, workplace organisation innovations and external relations management innovations. Our analysis focuses on research and development (R&D) departments, because research on workforce diversity suggests that the benefits deriving from diversity are more easily identified within a defined group or at a specific level of analysis (i.e. team, work group and department) (Subramanian *et al.*, 2016).

Our work contributes to the literature in the following ways. Firstly, it makes a theoretical contribution to innovation management research by examining the influence of workforce diversity on the development of non-technological innovations. Secondly, it extends the body of work on workforce diversity by analysing the relationship between task-related diversity and the intersectionality of gender. Thirdly, our analysis focuses on the role of workforce diversity in the context of R&D departments, where the contribution of women has not been clearly defined.

2. Task-related diversity, gender and organisational innovation

2.1 Workforce diversity and organisational innovation

The contemporary intensity of market conditions and consumer demands is challenging modern organisations, which are responding by innovating. Research shows that the positive impact of innovation extends beyond high-tech practices and R&D investment and includes non-technological drivers of business performance and economic growth (Anzola *et al.*, 2018). Many of these drivers are associated to organisational changes, which is prompting increased research.

Organisational innovation, generally understood as firm-level management innovations, is defined as the creation or adoption of new ideas or behaviours by the firm's social structure in response to environmental changes or to satisfy internal needs (Anzola *et al.*, 2018). The literature emphasises differences in the development and effects of organisational compared to other types of innovations, which has attracted more research into its determinants. In this study, we analyse the influence of workforce diversity and the intersectionality of gender as determinants of organisational innovations.

The influence of workforce diversity on firm innovation activities is the subject of debate in the literature. Studies in the resource-based view and absorptive capacity literatures find a positive influence. This stream of work shows that workforce diversity increases both the firm's knowledge base and the interactions among different types of knowledge, which creates an innovation-friendly environment (Ostergaard *et al.*, 2011). Several authors also suggest that workforce diversity provides informational advantages during the innovation process (Mohammadi *et al.*, 2017). Different employee perspectives serve as information filters and allow identification of relevant information, reducing information overlaps (Dahlin *et al.*, 2005). Thus, workforce diversity is considered positive for firms' innovation activities (Midavaine *et al.*, 2016; Mushtaq *et al.*, 2015; Parrotta *et al.*, 2014).

However, workforce diversity can also have negative effects. High levels of human resources diversity can lead to preferences for different approaches to a work task (Bell *et al.*, 2011) and result in conflict among individuals (Subramanian *et al.*, 2016). In addition, diversity can hamper communication among employees and slow decision-making (González-Moreno *et al.*, 2018; Srivastava and Lee, 2005). Some studies suggest that different perspectives can lead to miscommunication and uncertainty, which could result in the firm persisting with established practices and routines rather than introducing change (Solheim and Herstad, 2018). Excessive diversity can generate large amounts of information, which increase the costs of coordination and sharing and, subsequently, reduce cross-fertilisation of ideas (Ostergaard *et al.*, 2011). These potential downsides to diversity question whether workforce diversity affects the development of organisational innovation, which requires the participation of employees at different firm levels.

The empirical evidence fuelling this debate generally analyses the impact of workforce diversity on the achievement of technological innovations. Research shows that workforce diversity influences: the firm's propensity to undertake technological innovations (Bello-Pintado and Bianchi, 2020; Ostergaard *et al.*, 2011; Solheim and Herstad, 2018); the firm's R&D investment (Asad *et al.*, 2023; Midavaine *et al.*, 2016); the type of innovations achieved (Arslan *et al.*, 2021; Mohammadi *et al.*, 2017); the firm's patenting propensity (Faems and Subramanian, 2013; Lee and Chung, 2022; Yoo *et al.*, 2023), the number of the firm's patent applications (Subramanian *et al.*, 2016); and the firm's strategic innovation orientation (Hemmert *et al.*, 2022; Talke *et al.*, 2011; Zouaghi *et al.*, 2020).

Although the literature provides evidence of a link between workforce diversity and firm innovation activity, it does not show whether this link is present in the context of non-technological innovations such as organisational innovations. Work teams are becoming increasingly diverse, and organisational innovation may be affected by the characteristics of work groups. Therefore, it would seem important to analyse the effects of interdependence among members of more or less diverse groups on this type of innovation, which is related closely to the firm's structure and social processes.

2.2 Task-related diversity and organisational innovations

We contend that workforce diversity, in terms of employee education level and functional background (i.e. task-related diversity), affects the firm's propensity to introduce organisational innovations. Traditionally, education and functional background are variables related to job position and level of responsibility in the firm.

A focus on employee education level is particularly apt in the context of organisational innovation because education is related to mental ability and specialisation, and we expect that a mix of education levels will promote complementarities among workers, allowing skill enhancements (Quintana-García and Benavides-Velasco, 2008). Educational diversity in work teams should provide more cognitive resources and a broader perspective to promote recognition, selection and processing of external information and increase the ability to cope with new, unknown tasks (Quazi and Talukder, 2011). In addition, task division, based on education level, can produce complementarities useful to firms undertaking organisational change. For instance, highly skilled and specialised employees with advanced qualifications (doctoral or master's degree) are able to undertake more exploratory tasks and produce new knowledge (Subramanian *et al.*, 2016), while lower-educated workers can focus on repetitive tasks and standardised processes (Faems and Subramanian, 2013). For all these reasons, it can be assumed that education-level diversity allows for a range of approaches to organisational challenges. Thus, we hypothesise that:

H1. The greater the degree of education-level diversity among R&D employees, the more likely the firm will produce organisational innovations.

Employees have task-relevant knowledge and experience that can be combined to achieve organisational innovations. According to García-Martínez *et al.* (2017), functional background diversity emerges from the ability to deal with different issues and diverse conditions and, as a result, reflects the task-related knowledge, organisational routines and other knowledge embedded in the employee. Along similar lines, Bell *et al.* (2011) noted that employees occupying a particular role or spending considerable time on a specific task, are exposed to and influenced by information relevant to those tasks and, as a result, they develop beliefs consistent with their function.

Due to the informational advantages of diversity, a broader set of skills and responsibilities can be expected to lead to better decision-making during the procurement phase of organisational innovation. In contrast to technological innovations, management innovations require deep knowledge of the tasks and routines at different firm levels, and functional background diversity could provide different perspectives on organisational problems. Also, as van Knippenberg and Schippers (2007) noted, varying perspectives and divergent viewpoints invite employees to reflect on their own functioning.

Studies analysing the impact of functional background diversity on the firm's innovation process (in the context of technological innovation) use several measures, including experience in different functional areas and degree of involvement in the task (Sastre, 2015; García-Martínez *et al.*, 2017; Solheim and Herstad, 2018). In general, these studies find a positive and significant correlation between the firm's innovation activity and functional background diversity. Thus, we hypothesise that:

H2. The greater the degree of functional background diversity of R&D employees, the more likely the firm will produce organisational innovations.

2.3 A gender perspective

The push for increased representation of women in firms is increasing the focus on gender in the diversity literature (Ali *et al.*, 2015). However, the stream of work on gender diversity in the workplace is not in agreement about its effects (An, 2022) and mostly proposes two different views. The value-in-diversity perspective posits that gender diversity provides potential advantages, stemming from cognitive diversity (García-Martínez *et al.*, 2017), which are manifested as different approaches to addressing and resolving issues that arise within work teams (Hong and Page, 2004). These different approaches result in a wealth of information, knowledge, skills and ideas, which enhance the group's problem-solving capacity and facilitate the generation of strategic alternatives (Post and Byron, 2015; Teruel and Segarra, 2017; Torchia *et al.*, 2018). On the other hand, social identity theory suggests that gender diversity triggers comparison and social categorisation, leading individuals within social groups to establish relationships with others with similar attributes (Tajfel and Turner, 2004) and ignore those with opposing ideas (González-Moreno *et al.*, 2018). Thus, social identity theory contends that if gender diversity causes reduced communication and collaboration among team members, this could lead to team break down, which inevitably impedes adoption of novel ideas (Chapple and Humphrey, 2014; González-Moreno *et al.*, 2018). These opposing perspectives have fuelled debate on the influence of workforce diversity and gender.

Work on firms' innovative activity mostly investigates whether firms with balanced gender composition are more innovative than firms with a high concentration of one gender. The results of this work are mixed. For example, Midavaine *et al.* (2016), García-Martínez *et al.* (2017), Mohammadi *et al.* (2017), Xie *et al.* (2020), Zouaghi *et al.* (2020), Lee and Chung (2022) and Hemmert *et al.* (2022) found a positive and significant relationship between gender diversity and firm innovation capacity, whereas Asad *et al.* (2023) found a significant and negative relationship with firm propensity to invest in R&D. Faems and Subramanian (2013) and Yoo *et al.* (2023) found a non-direct linear effect on patent applications.

The study by Teruel and Segarra (2017) provided evidence of a positive impact of gender diversity on innovation, but highlighted that this impact differs with the type of innovation and firm size. Their results show that small firms find it more difficult to exploit the advantages of greater gender diversity. Similarly, Sastre (2015) noted varying effects of gender diversity on innovation outcomes, identifying a curvilinear relationship. The study concludes that beyond a certain point, increased gender diversity hampers interaction and undermines group cohesion, negatively affecting innovation. Along the same lines, Ostergaard *et al.* (2011) noted that the likelihood of innovation activity increases if there is a good gender balance in the innovation team. These studies indicate a gap in our understanding of the specific role of gender in the firm's innovation process. According to van Knippenberg and Schippers (2007), gender diversity research fails to capture the impact of women because it treats groups with a minority of men and groups with a comparable minority of women as equally diverse (e.g. eight men and two women vs two men and eight women). Also, these studies rule out the possibility of diversity in all-women groups.

We aim to advance the investigation of the role o,f women in firms' innovation activities by analysing the impact of task-related diversity among women, based on education level and functional background. The role of women has been somewhat overlooked in the innovation literature, with mixed results from those few studies that do consider it. Although Yang and Konrad (2011) found that a high percentage of women increases the firm's propensity to introduce innovations, Lee *et al.* (2005) and Arvanitis and Stucki (2012) showed that the presence of more men increases the firm's propensity to patent and conduct R&D activities. At the organisational innovation level, Awamleh (1994) and Damanpour and Schneider (2006) found no significant impact of women.

Traditionally, the effect of women on firm performance has focused more on women in senior positions, such as chief executive officer or as members of the top management team (TMT), and much less on women's presence in work groups and departments. This interdisciplinary literature adopts a broad theoretical lens to predict the impact of women's participation. In an effort to integrate a theoretical background, Jeong and Harrison (2017) provided a meta-analysis of the gender literature, highlighting at least three ideas guiding work in this field. The first is that women provide the firm with a distinct attitude to risk-taking and a unique cache of knowledge that induces less risky firm strategies. The authors suggest that the literature supports the notion of women's greater risk-averseness. The second idea is that the representation of women in TMTs influences the firm's decision-making process and reduces group polarisation and the preference for risk typical of all-male TMTs. Thirdly, women's participation in male-dominated groups changes the status quo in decision processes by increasing discussion, providing access to more sources of information and introducing new perspectives. In sum, as highlighted in Pletzer *et al.'s* (2015) meta-analysis, increased presence of women in decision-making is associated to the introduction of new leadership skills and a variety of strategic advantages. In the innovation management literature, the focus on gender is justified by differences between men and women in terms of leadership style, communication style, values and socialisation (Damanpour and Schneider, 2006).

A focus on women is interesting in the context of innovation management, in particular, because of the well-known gender differences in education and job training (Carrasco, 2014).

For example, the participation of women is lower in the natural sciences, technology, engineering and mathematics (STEM) areas (Carrasco, 2014; Lerchenmueller and Sorenson, 2018) and in the top hierarchies of firms (Jeong and Harrison, 2017). To our knowledge, there are no studies analysing the impact of women's task-related diversity (in terms of education level and functional background) on firms' innovation activity despite calls for a better understanding of the gendered aspects of the innovation process. Thus, we hypothesise that:

H3. The greater the level of education diversity among women in the R&D unit, the more likely the firm will produce organisational innovations.

H4. The greater the level of functional background diversity among the women in the R&D unit, the more likely the firm will produce organisational innovations.

3. Methodology

3.1 Data

For this investigation, we used the 2013 data set from the Technological Innovation Panel (PITEC), managed by Spain's National Institute of Statistics. The 2013 edition was selected due to its status as the most contemporaneous data set publicly accessible during the time frame of this study. It should be noted that this particular data set, as well as more recent editions, are currently unavailable for further scholarly inquiry. The data include over 12,000 Spanish firms, particularly those with R&D departments and a workforce that exceeds 200 employees. Our analysis focuses on 8,993 firms, 35.07% of which reported organisational innovation activity in the years 2011–2013. The data include the manufacturing and service sectors, and provide detailed information on R&D employee qualifications and roles. This enables a nuanced investigation into how workforce diversity influences organisational innovation. Although a longitudinal study was not feasible due to overlapping response timeframes, this data set is invaluable in the context of our research questions due, in particular, to its unique information on gender issues in R&D departments.

3.2 Variables

3.2.1 Dependent variable. Organisational innovation (OI) is our dependent variable. In PITEC, OI is a binary variable for each of the three possible innovations classified as organisational. This captures whether the firm introduced:

(1) new business practices related to the organisation of the firm's work or procedures (OI-Type I);

(2) new organisational methods to improve the distribution of responsibility and decision-making (OI-Type II); and

(3) new methods to manage relations with other firms and public institutions (OI-Type III).

We built other binary variables for each type of organisational innovation described in the survey.

3.2.2 Task-related diversity indexes. Diversity indexes were obtained using the Shannon–Weaver index, which is easy to estimate and produces fewer standard errors, and is calculated as follows:

$$H = -\sum_{i=1}^{S} p_i \log p_i$$

where p_i is the share of employees in the ith category and S is the number of categories or groups of individuals. To estimate education diversity, we consider four groups of R&D department employees:

(1) doctoral graduate employees;
(2) university graduates;
(3) employees with a college diploma; and
(4) employees with higher or medium vocational training, high school or other level studies.

In the case of functional background diversity, we consider three categories of employees:

(1) researchers (individuals responsible for creating new knowledge, products and processes);
(2) technicians (individuals whose main tasks are related to technical knowledge and whose tasks also include the application of operative methods; they are generally supervised by a researcher); and
(3) support staff (other R&D department staff who facilitate the department's smooth running and provide management support for R&D projects).

The H index increases with R&D worker richness and diversity; if the firm's R&D employees belong to the same group, the firm takes the value 0. Maximum diversity is calculated as the natural logarithm of S.

3.2.3 Control variables. We follow the literature and consider other variables that might determine organisational innovation (Castro *et al.*, 2011; Jaskyte, 2013; Montoro-Sánchez *et al.*, 2012). For firm structural characteristics, we consider firm size (logarithm of the number of employees), foreign capital (1 if the firm is based on more than 50% foreign capital), firm age (number of years to 2013 since firm creation) and percentage of women in the firm to control for gender participation. We include three dichotomous variables for high- or médium-technology manufacturing sector or knowledge-intensive service sector (based on the European Union sector classification). Because the literature suggests a relationship between technological innovation and organisational changes (Hecker and Ganter, 2013; Yang and Konrad, 2011), we include several indicators of firm innovation activity. We include dichotomous variables for:

- location in a science and technology park; and
- R&D cooperation agreements.

Finally, to reduce endogeneity problems, we consider R&D intensity in the previous period ($t-1$). Table 1 presents descriptive statistics of the dependent and explanatory variables and their correlations.

3.3 Method

The descriptive statistics show a marked imbalance of 0 to 1 in the dependent variable for organisational innovation (only 35.07% of firms introduced OI); this suggests use of a

Table 1. Correlation matrix and descriptive statistics

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Organisational innovation	1.00												
2. Educational diversity index	0.27	1.00											
3. Functional background diversity index	0.24	0.81	1.00										
4. % of women in the firm	0.04	−0.05	−0.05	1.00									
5. Foreign capital	0.08	0.06	0.05	−0.01	1.00								
6. Firm age	0.08	0.06	0.08	−0.02	0.09	1.00							
7. High-technology manufacturing sector	0.05	0.16	0.14	0.01	0.04	0.00	1.00						
8. Medium-technology manufacturing sector	0.02	0.15	0.16	−0.23	0.03	0.06	−0.11	1.00					
9. Knowledge-based services sector	0.04	0.13	0.06	0.08	−0.02	−0.09	−0.04	−0.11	1.00				
10. Firm size	0.22	0.18	0.16	0.17	0.25	0.27	−0.01	−0.05	−0.04	1.00			
11. Cooperation in R&D	0.28	0.46	0.39	−0.01	0.07	0.04	0.07	0.02	0.09	0.19	1.00		
12. Location in STP	0.06	0.14	0.08	0.03	−0.03	−0.09	0.06	−0.05	0.17	−0.02	0.13	1.00	
13. R&D intensity ($t-1$)	0.11	0.39	0.28	0.03	−0.07	−0.16	0.11	−0.06	0.39	−0.16	0.30	0.27	1.00
Mean	0.34	0.24	0.24	32.96	0.12	29.63	0.04	0.23	0.04	3.97	0.25	0.04	3.61
SD	0.47	0.35	0.37	24.99	0.33	20.28	0.19	0.42	0.20	1.79	0.43	0.1	9.04

Source: Authors' own work

generalised linear model (GLM) with a binomial family and log–log extension. GLM is also used to control for problems of over-dispersion, which, in models with a binary response variable, could generate inaccurate standard error estimates and inconsistent results. We used the Huber–White sandwich estimator to address heteroscedasticity concerns. Given an average variance inflation factor of 1.55 and a maximum value of 3.47, multicollinearity does not seem to be a problem in our models.

4. Results

In this study, we examine the impact of education and functional background diversity on the firm's propensity to achieve organisational innovations. Table 2 displays the outcomes for the influence of diversity on overall organisational innovation; Table 3 presents the results for specific types of organisational innovation. To analyse the influence of gender, we include the explanatory variables education diversity and functional background diversity among women [1] employed in the R&D department.

As shown in Table 2, Model 0 includes only the control variables; Models 1–6 present the estimations including the diversity indexes. The results show that, in general, variables such as firm size, firm age, high proportion of foreign capital, good proportion of women in the firm, R&D cooperation and previous R&D intensity have a positive and significant effect on increasing the firm's propensity to introduce organisational changes. However, the impact of firm sector is unclear and depends on inclusion of the diversity indexes. These results are in line with the literature showing that organisational innovations are more frequent in large innovative firms able to guarantee innovation process continuity (Castro *et al.*, 2011; Laforet, 2013; Montoro-Sánchez *et al.*, 2012).

We next study the effect of task-related diversity (see Table 2). Models 1–3 display the estimations for the impact of the diversity indexes of total R&D employment; Models 4–6 present the estimates for the impact of the diversity indexes of women. Models 1–3 show that education diversity in the R&D team has a positive and significant influence on the achievement of organisational innovation, and this effect persists if we include functional background diversity. To derive the percentage change in the expected propensity for OI as a result of a change in diversity, we use the formula (exp[β] $-$ 1) $\times$ 100 based on the [β] coefficients in Table 2. The results of Model 3 show that a change in education diversity increases the expected propensity to undertake organisational innovation by more than 62.90 percentage points [(exp (0.488) $-$ 1) $\times$ 100]. This generally supports *H1*. The results for functional background diversity are similar. Model 3 shows that a change in the level of diversity increases the chances of organisational innovation by more than 19.12%, which supports *H2*. These results show that both dimensions of task-related diversity explain organisational innovation.

We analysed the impact of diversity among the women working in the R&D department. In Model 6, which includes the functional background diversity index, women's education diversity has no significant impact, which rejects *H3*. However, we find that women's functional background diversity has a positive and significant impact. A change in the level of women's functional background diversity increases the firm's expected propensity to undertake organisational innovation by more than 78.60 percentage points [(exp (0.580) $-$ 1) $\times$ 100], which provides general support for *H4*.

We also examined the influence of R&D workers' education diversity and functional background diversity on the three types of organisational innovation considered (see Table 3). Based on the diversity in the group of R&D employees, the results show that education diversity has a positive and significant influence in all cases (OI Type I, Type II and Type III). However, we observe that functional background diversity has a positive and significant

Table 2. Effects of the task-related diversity on organisational innovations

Variables	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Educational diversity		0.639*** (0.053)		0.488*** (0.079)			
Women educational diversity					0.747*** (0.092)		0.165 (0.169)
Functional background diversity			0.494*** (0.046)	0.175** (0.069)			
Women functional background diversity						0.702*** (0.078)	0.580*** (0.147)
Firm size	0.140*** (0.009)	0.118*** (0.009)	0.124*** (0.009)	0.118*** (0.009)	0.126*** (0.009)	0.125*** (0.009)	0.125*** (0.009)
% of women in the firm	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.001 (0.001)	0.001* (0.001)	0.001 (0.001)
Foreign capital	0.099** (0.046)	0.106** (0.046)	0.107** (0.046)	0.107** (0.046)	0.093** (0.046)	0.098** (0.046)	0.097** (0.046)
Firm age	0.002*** (0.001)	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
High-technology manufacturing sector	0.195*** (0.075)	0.054 (0.077)	0.093 (0.076)	0.051 (0.077)	0.126* (0.077)	0.134* (0.077)	0.129* (0.077)
Medium-technology manufacturing sector	0.134*** (0.035)	0.043 (0.036)	0.062* (0.035)	0.039 (0.036)	0.099*** (0.035)	0.099*** (0.035)	0.098*** (0.035)
Knowledge-based services sector	0.027 (0.081)	0.026 (0.081)	0.053 (0.081)	0.035 (0.081)	−0.012 (0.081)	0.010 (0.081)	0.005 (0.081)
R&D intensity ($t-1$)	0.013*** (0.002)	0.004** (0.002)	0.008*** (0.002)	0.005** (0.002)	0.007*** (0.002)	0.008*** (0.002)	0.007*** (0.002)
Location in STP	0.116 (0.075)	0.091 (0.076)	0.122 (0.075)	0.099 (0.076)	0.093 (0.076)	0.098 (0.076)	0.096 (0.077)
R&D cooperation	0.656*** (0.038)	0.515*** (0.040)	0.554*** (0.039)	0.512*** (0.040)	0.570*** (0.040)	0.552*** (0.040)	0.551*** (0.040)
Constant	−1.010*** (0.043)	−0.980*** (0.043)	−0.996*** (0.043)	−0.982*** (0.043)	−0.951*** (0.044)	−0.956*** (0.043)	−0.953*** (0.043)
(1/df) Pearson	0.998	0.997	0.998	0.999	0.998	0.998	0.997
AIC	1.178	1.161	1.165	1.161	1.170	1.169	1.161
BIC	−71197.65	−71343.26	−71310.27	−71340.73	−71262.21	−71277.26	−71340.73
No. of observations	8,993	8,933	8,993	8,993	8,993	8,993	8,993

Notes: *** $p < 0.001$; **$p < 0.05$ and *$p < 0.10$. Robust standard errors are shown within brackets; AIC = Akaikes's information criterion; BIC = Bayesian information criterion

Source: Authors' own work

Table 3. Impact of the diversity indexes on the different organisational innovation types

Variables	The whole R&D unit OI Type I Model 1	OI Type II Model 2	OI Type III Model 3	Women in the R&D unit OI Type I Model 4	OI Type II Model 5	OI Type III Model 6
Educational diversity	0.481*** (0.075)	0.439*** (0.074)	0.389*** (0.071)	0.232 (0.161)	0.174 (0.157)	0.303** (0.146)
Functional background diversity	0.168*** (0.066)	0.128** (0.065)	−0.003 (0.063)	0.485*** (0.139)	0.473*** (0.137)	0.124 (0.129)
Firm size	0.127*** (0.009)	0.103*** (0.009)	0.080*** (0.009)	0.134*** (0.009)	0.109*** (0.009)	0.085*** (0.009)
% of women in the firm	0.002*** (0.001)	0.002*** (0.001)	0.001** (0.001)	0.000 (0.001)	0.001** (0.001)	0.001 (0.001)
Foreign capital	0.094** (0.045)	0.125*** (0.044)	−0.035 (0.044)	0.082* (0.045)	0.116*** (0.044)	−0.043 (0.044)
Firm age	0.001** (0.001)	0.002*** (0.001)	0.000 (0.001)	0.002** (0.001)	0.002*** (0.001)	0.000 (0.001)
High-technology manufacturing sector	0.105 (0.074)	0.029 (0.072)	−0.046 (0.074)	0.182** (0.074)	0.093 (0.072)	−0.006 (0.074)
Medium-technology manufacturing sector	0.032 (0.035)	0.090*** (0.035)	−0.066* (0.037)	0.094*** (0.034)	0.142*** (0.034)	−0.024 (0.035)
Knowledge-based services sector	−0.024 (0.078)	0.018 (0.077)	0.028 (0.078)	−0.051 (0.079)	−0.011 (0.078)	0.019 (0.079)
R&D intensity ($t-1$)	0.003 (0.002)	0.003 (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.005*** (0.002)	0.008*** (0.002)
Location in STP	0.008 (0.072)	0.123* (0.071)	0.133** (0.068)	0.002 (0.072)	0.121* (0.072)	0.133* (0.069)
R&D cooperation	0.420*** (0.038)	0.394*** (0.037)	0.391*** (0.035)	0.463*** (0.037)	0.425*** (0.037)	0.432*** (0.035)
Constant	−1.166*** (0.044)	−1.112*** (0.043)	−1.376*** (0.046)	−1.132*** (0.044)	−1.082*** (0.043)	−1.348*** (0.046)
(1/df) Pearson	0.999	0.998	1.001	1.000	0.999	1.001
AIC	1.059	1.075	0.682	1.068	1.081	0.685
BIC	−72256.55	−72112.48	−75652.86	−72174.9	−72056.05	−75617.91
No. of observations	8,993	8,993	8,993	8,993	8,933	8.993

Notes: ***$p < 0.001$; **$p < 0.05$ and *$p < 0.10$. Robust standard errors are shown within brackets
Source: Authors' own work

influence only on Type I and II organisational innovations. In general, our results show that task knowledge variety is not a determinant of the introduction of new ways to manage external relations with other firms or public institutions (OI Type III). This is also true for the impact of women's functional background diversity (Model 6); education diversity might be sufficient for companies to improve the management of their external relations.

Table 3 shows some differences in the determinants of organisational innovation when considering the type of innovation. For instance, we observe that firm age, high levels of foreign capital and belonging to a high- or medium-technology sector increase the propensity for Types I and II organisational innovation, which are related to improving workplace organisation and distribution of responsibility and decision-making. We found that firm location in a science park and previous R&D intensity are determinants of Type III organisational innovation.

As shown in Table 3, Models 4–6 present gendered aspects of the influence of workforce diversity on different types of organisational innovation. Women's education diversity has a positive and significant influence on the firm's propensity to introduce management of external relationship innovations (OI Type III) but not on other types of organisational innovation. In addition, we show that women's functional background diversity is a determinant of the introduction of new business practices related to the organisation of the firm's work and processes (OI Type I) and new organisational methods to improve the distribution of responsibility and decision-making (OI Type II). Thus, the participation of women and their diversity play different roles in the case of firm organisational changes.

Based on the differences we found for the impact of women's diversity (Tables 2 and 3) and the lack of knowledge about the role of women in R&D activities, we extended the analysis to examine which group of women (in the R&D team) have more influence on the firm's propensity to produce organisational innovations (in general). Table 4 reveals that women with a doctoral degree have no significant impact compared to women with lower level (undergraduate degree or college diploma) education. Women with a doctorate might be more involved in scientific and technological tasks than in management activities, while those with lower levels of education might be more likely to occupy management positions in the R&D department and might be expected to have a broader knowledge of the internal organisation and be better able to propose improvements and resolve management conflicts. The results change if we analyse the impact of women's functional roles. The percentage of women researchers and technicians (as opposed to the proportion of women among the support staff) increases the firms' propensity to introduce organisational changes. We observe that women occupying more senior positions in the R&D department hierarchy have a bigger influence on the development of organisational innovations than the influence of a higher level of education.

4.1 Robustness checks

Table 5 reports the results of a supplementary analysis to check the robustness of our findings. We introduced quadratic terms of the diversity indexes. The estimation results are consistent with those in Table 2. However, we observe curved relationships between task-related diversity indexes and organisational innovations. If we focus on diversity among total R&D employees, we find that the squared term of education diversity has a significant negative impact on organisational innovations. Figure 1 shows that the firm's propensity to produce organisational innovations increases with increasing education diversity peaks and then declines slightly. We also found curved relationships for women's diversity. Model 2 shows a significant negative impact of the squared term of women's functional background diversity on organisational innovations. Figure 2 shows an inverted U-shaped curve for the

Variables	Model 1	Model 2
% women with doctorate	0.004 (0.003)	
% women with university degree	0.007*** (0.002)	
% women with college diploma	0.008*** (0.003)	
% women researchers		0.006*** (0.001)
% women technicians		0.009*** (0.002)
% women supporting staff		0.003 (0.002)
Firm size	0.135*** (0.009)	0.134*** (0.009)
% of women in the firm	0.001* (0.001)	0.001 (0.001
Foreign capital	0.095** (0.046)	0.101** (0.046)
Firm age	0.002*** (0.001)	0.002*** (0.001)
High-technology manufacturing sector	0.156** (0.076)	0.149** (0.076)
Medium-technology manufacturing sector	0.118*** (0.035)	0.111*** (0.035)
Knowledge-based services sector	0.016 (0.081)	0.021 (0.081)
R&D intensity ($t-1$)	0.010*** (0.002)	0.009*** (0.002)
Location in STP	0.112 (0.076)	0.113 (0.076)
R&D cooperation	0.616*** (0.039)	0.583*** (0.039)
Constant	−0.985*** (0.043)	−0.979*** (0.043)
(1/df) Pearson	0.998	0.999
AIC	1.175	1.171
BIC	−71203.34	−71243.88
No. of observations	8,993	8,993

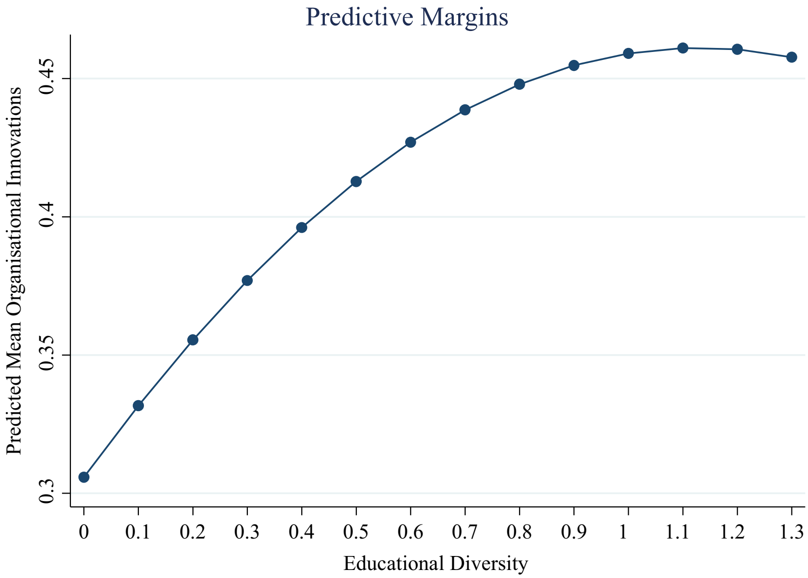
Notes: ***$p < 0.001$; **$p < 0.05$ and *$p < 0.10$. Robust standard errors are shown within brackets
Source: Authors' own work

Table 4.
Impact of the R&D unit working women on organisational innovations

Variables	General Model 1	Women Model 2
Educational diversity	0.807*** (0.193)	0.232 (0.418)
Educational diversity sq	−0.357** (0.174)	−0.139 (0.426)
Functional background diversity	0.418* (0.216)	1.262*** (0.368)
Functional background diversity sq	−0.296 (0.204)	−0.985*** (0.373)
Firm size	0.118*** (0.009)	0.122*** (0.009)
% women in the firm	0.002*** (0.001)	0.001* (0.001)
Foreign capital	0.109** (0.046)	0.098** (0.046)
Firm age	0.002** (0.001)	0.002*** (0.001)
High-technology manufacturing sector	0.054 (0.077)	0.135* (0.076)
Medium-technology manufacturing sector	0.038 (0.036)	0.094*** (0.035)
Knowledge-based services sector	0.044 (0.081)	0.015 (0.081)
R&D intensity ($t-1$)	0.004* (0.002)	0.007*** (0.002)
Location in STP	0.105 (0.076)	0.096 (0.077)
R&D cooperation	0.500*** (0.040)	0.532*** (0.040)
Constant	−0.995** (0.044)	−0.959*** (0.043)
(1/df) Pearson	0.997	0.998
AIC	1.160	1.168
BIC	−71330.98	−71266.34
No. of observations	8,993	8,993

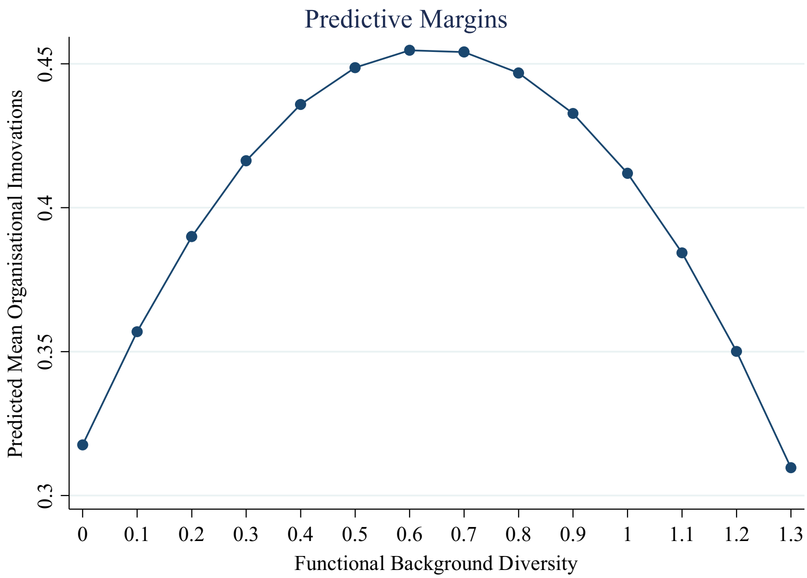
Notes: ***$p < 0.001$; **$p < 0.05$ and *$p < 0.10$. Robust standard errors are shown within brackets
Source: Authors' own work

Table 5.
Non-linear relationships between the diversity indexes and the organisational innovations



Source: Authors own work

Figure 1. The propensity adjusted mean to undertake OI according to educational diversity considering the whole of R&D employees



Source: Authors own work

Figure 2. The propensity adjusted mean to undertake OI in relation to the functional background diversity of the R&D unit working women

firm's propensity to produce organisational innovations, which increases with increasing diversity up to a midpoint and then declines.

5. Discussion

Our results show that, when controlling for other factors, such as firm size, age, industry, foreign capital participation, location and R&D activities, task-related diversity (in terms of employees' education level and functional background) increases the firm's propensity to undertake organisational innovations. These findings are in line with existing studies (Bello-Pintado and Bianchi, 2020; Faems and Subramanian, 2013; Midavaine *et al.*, 2016; Ostergaard *et al.*, 2011; Sánchez *et al.*, 2023; Subramanian *et al.*, 2016; Solheim and Herstad, 2018; Talke *et al.*, 2011; Tonoyan and Boudreaux, 2023).

We also examined how task-related diversity impacts different types of organisational innovation. We found that the influence of each diversity type varies based on the innovation in question. Specifically, educational diversity and functional background diversity both positively affect internal organisational changes such as new knowledge management methods or new decision-making structures. However, in the case of management of external relationships with other organisations and public institutions, only educational diversity is significant. This suggests that firms should consider in depth which kinds of diversity will be most beneficial for their particular innovation goals.

Our gender-focused analysis found that a larger proportion of women in the firm has a positive effect on organisational innovation and also showed that women's diversity plays different roles. Interestingly, in the case of women, functional background diversity is more significant than education diversity for influencing organisational changes.

It also seems that the role of women in the innovation process is nuanced. In the case of women's education levels, we found that having a PhD degree had no significant impact on the firm's propensity to produce organisational innovations, while an undergraduate degree or a college diploma has a positive and significant impact. The findings differ for the functional role of women. We observed that women in more senior positions in the R&D department hierarchy have more influence on the development of organisational innovations, reinforcing the idea that more women in the TMT is beneficial (Jeong and Harrison, 2017; Pletzer *et al.*, 2015). Therefore, firms should consider not only gender composition but also the specific roles occupied by women in the R&D unit.

Lastly, our supplementary analysis to check the robustness of our results revealed a nuanced relationship between diversity and innovation. After a certain point, increased diversity shows diminishing returns, in some cases leading to decreased innovation. The curvilinear association proposed by Sastre (2015) is evident in relation to education diversity among total R&D staff and functional background diversity among women. Excessive diversity can hamper organisational innovation, suggesting the need for diversity initiatives to consider this aspect in some detail. These findings suggest that merely increasing the number of women in a firm might not be sufficient to foster innovation.

6. Conclusion and implications

Our study enriches our understanding of the role of task-related diversity for organisational innovation by illustrating how its impact varies across different types of innovation. Our inclusion of a gender-focused analysis adds depth to the complexity of this relationship. Our findings show a positive association between a higher percentage of women in the R&D department and organisational innovation. Importantly, we also show that within the cohort of women, functional background diversity has a more significant impact on organisational changes than does education diversity. The gender analysis underlines the multifaceted contribution to innovation made by women and highlights how different education attainment and functional roles among women have a distinct influence on organisational innovation outcomes.

We contribute to the academic literature on diversity in the workforce and gender perspectives and points to the importance of examining the diversity within specific departments and roles, and especially among women in R&D departments.

For practitioners and organisational leaders, understanding these nuances could lead to more effective diversity management strategies. Increasing the size of the female workforce might be beneficial, but consideration should also be given to which specific types of diversity will yield the most impactful results. Our study also points to the importance of the presence of women in senior positions for the innovation process and suggests that appointing women to R&D leadership roles could result in substantial benefits for the firm.

The limitations of our study, which include the use of cross-sectional data and data from secondary sources, suggest the need for further research to explore these relationships in more depth. Future work could include longitudinal analyses and data on firms' management policies and practices; this potentially might alter or modify the impact of diversity on innovation.

Note

1. In the PITEC data, gender is measured as a binary variable. Therefore, any finding regarding the influence of the percentage of women inherently implies the inverse for the percentage of men.

References

Ali, M., Metz, I. and Kulik, C.T. (2015), "Retaining a diverse workforce: the impact of gender-focused human resource management", *Human Resource Management Journal*, Vol. 25 No. 4, pp. 580-599, doi: 10.1111/1748-8583.12079.

Ali, F., Wang, M., Jebran, K. and Ali, S.T. (2021), "Board diversity and firm efficiency: evidence from China", *Corporate Governance: The International Journal of Business in Society*, Vol. 21 No. 4, pp. 587-607, doi: 10.1108/CG-10-2019-0312.

An, S. (2022), "Board diversity and monitoring: an investigation of gender and task-related diversity", *Public Performance and Management Review*, Vol. 45 No. 1, pp. 54-79, doi: 10.1080/15309576.2021.1914691.

Anzola, R.P., Bayona-Sáez, C. and García-Marco, T. (2018), "Organizational innovation, internal R&D and externally sourced innovation practices: effects on technological innovation outcomes", *Journal of Business Research*, Vol. 91, pp. 233-247, doi: 10.1016/j.jbusres.2018.06.014.

Arslan, A., Haapanen, L., Ahokangas, P. and Naughton, S. (2021), "Multicultural R&D team operations in high-tech SMEs: role of team task environment and individual team members' personal experiences", *Journal of Business Research*, Vol. 128, pp. 661-672, doi: 10.1016/j.jbusres.2020.02.003.

Arvanitis, S. and Stucki, T. (2012), "What determines the innovation capability of firm founders?", *Industrial and Corporate Change*, Vol. 21 No. 4, pp. 1049-1084, doi: 10.1093/icc/dts003.

Asad, M., Akbar, S., Li, J. and Shah, S.Z.A. (2023), "Board diversity and corporate propensity to R&D spending", *International Review of Financial Analysis*, Vol. 89, p. 102802, doi: 10.1016/j.irfa.2023.102802.

Awamleh, N.I.A. (1994), "Managerial innovation in the civil service in Jordan: a field study", *Journal of Management Development*, Vol. 13 No. 9, pp. 52-60, doi: 10.1108/02621719410072099.

Basheer, M.F., Saleem, M., Hameed, W.U. and Hassan, M.M. (2021), "Employee voice determinants and organizational innovation: does the role of senior manager matter", *Psychology and Education Journal*, Vol. 58 No. 3, pp. 1624-1638, doi: 10.17762/pae.v58i3.3903.

Bell, S.T., Villado, A.J., Lukasik, M.A., Belau, L. and Briggs, A.L. (2011), "Getting specific about demographic diversity variable and team performance relationships: a meta-analysis", *Journal of Management*, Vol. 37 No. 3, pp. 709-743, doi: 10.1177/0149206310365001.

Bello-Pintado, A. and Bianchi, C. (2020), "Workforce education diversity, work organization and innovation propensity", *European Journal of Innovation Management*, Vol. 24 No. 3, pp. 756-776, doi: 10.1108/ejim-10-2019-0300.

Binnewies, C., Ohly, S. and Niessen, C. (2008), "Age and creativity at work: the interplay between job resources, age and idea creativity", *Journal of Managerial Psychology*, Vol. 23 No. 4, pp. 438-457, doi: 10.1108/02683940810869042.

Carrasco, I. (2014), "Gender gap in innovation: an institutionalist explanation", *Management Decision*, Vol. 52 No. 2, pp. 410-424, doi: 10.1108/MD-07-2012-0533.

Castro, L.M., Montoro-Sánchez, A. and Ortiz-De-Urbina-Criado, M. (2011), "Innovation in services industries: current and future trends", *The Service Industries Journal*, Vol. 31 No. 1, pp. 7-20, doi: 10.1080/02642069.2010.485196.

Chapple, L. and Humphrey, J.E. (2014), "Does board gender diversity have a financial impact? Evidence using stock portfolio performance", *Journal of Business Ethics*, Vol. 122 No. 4, pp. 709-723, doi: 10.1007/s10551-013-1785-0.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-152, doi: 10.2307/2393553.

Dahlin, K.B., Weingart, L.R. and Hinds, P.J. (2005), "Team diversity and information use", *Academy of Management Journal*, Vol. 48 No. 6, pp. 1107-1123, doi: 10.5465/amj.2005.19573112.

Damanpour, F. (2020), *Organizational Innovation: Theory, Research, and Direction*, Edward Elgar Publishing.

Damanpour, F. and Schneider, M. (2006), "Phases of the adoption of innovation in organizations: effects of environment, organization and top managers", *British Journal of Management*, Vol. 17 No. 3, pp. 215-236, doi: 10.1111/j.1467-8551.2006.00498.x.

Faems, D. and Subramanian, A.M. (2013), "R&D manpower and technological performance: the impact of demographic and task-related diversity", *Research Policy*, Vol. 42 No. 9, pp. 1624-1633, doi: 10.1016/j.respol.2013.06.001.

García-Martínez, M., Zouaghi, F. and García-Marco, T. (2017), "Diversity is strategy: the effect of R&D team diversity on innovative performance", *R&D Management*, Vol. 47 No. 2, pp. 311-329, doi: 10.1111/radm.12244.

Georgakakis, D., Greve, P. and Ruigrok, W. (2017), "Top management team faultlines and firm performance: examining the CEO-TMT interface", *The Leadership Quarterly*, Vol. 28 No. 6, pp. 741-758, doi: 10.1016/j.leaqua.2017.03.004.

González-Moreno, A., Díaz-García, C. and Sáez-Martínez, F.J. (2018), "R&D team composition and product innovation: gender diversity makes a difference", *European Journal of International Management*, Vol. 12 No. 4, pp. 423-446, doi: 10.1504/EJIM.2018.092843.

Hecker, A. and Ganter, A. (2013), "The influence of product market competition on technological and management innovation: firm-level evidence from a large-scale survey", *European Management Review*, Vol. 10 No. 1, pp. 17-33, doi: 10.1111/emre.12005.

Hemmert, M., Cho, C.K. and Lee, J.Y. (2022), "Enhancing innovation through gender diversity: a two-country study of top management teams", *European Journal of Innovation Management*, doi: 10.1108/EJIM-08-2021-0383.

Hong, L. and Page, S.E. (2004), "Groups of diverse problem solvers can outperform groups of high-ability problem solvers", *Proceedings of the National Academy of Sciences*, Vol. 101 No. 46, pp. 16385-16389, doi: 10.1073/pnas.0403723101.

Jaskyte, K. (2013), "Does size really matter? Organizational size and innovations in nonprofit organizations", *Nonprofit Management and Leadership*, Vol. 24 No. 2, pp. 229-247, doi: 10.1002/nml.21087.

Jeong, S.H. and Harrison, D.A. (2017), "Glass breaking, strategy making, and value creating: meta-analytic outcomes of women as CEOs and TMT members", *Academy of Management Journal*, Vol. 60 No. 4, pp. 1219-1252, doi: 10.5465/amj.2014.0716.

Laforet, S. (2013), "Organizational innovation outcomes in SMEs: effects of age, size, and sector", *Journal of World Business*, Vol. 48 No. 4, pp. 490-502, doi: 10.1016/j.jwb.2012.09.005.

Lee, J. and Chung, J. (2022), "Women in top management teams and their impact on innovation", *Technological Forecasting and Social Change*, Vol. 183, p. 121883, doi: 10.1016/j.techfore.2022.121883.

Lee, S.H., Wong, P.K. and Chong, C.L. (2005), "Human and social capital explanations for R&D outcomes", *IEEE Transactions on Engineering Management*, Vol. 52 No. 1, pp. 59-68, doi: 10.1109/TEM.2004.839955.

Lerchenmueller, M.J. and Sorenson, O. (2018), "The gender gap in early career transitions in the life sciences", *Research Policy*, Vol. 47 No. 6, pp. 1007-1017, doi: 10.1016/J.RESPOL.2018.02.009.

Liu, Z., Ge, L. and Peng, W. (2016), "How organizational tenure affects innovative behavior? The role of culture difference and status determinants", *Nankai Business Review International*, Vol. 7 No. 1, pp. 99-126, doi: 10.1108/NBRI-01-2016-0001.

Midavaine, J., Dolfsma, W. and Aalbers, R. (2016), "Board diversity and R&D investment", *Management Decision*, Vol. 54 No. 3, pp. 558-569, doi: 10.1108/MD-09-2014-0574.

Mohammadi, A., Broström, A. and Franzoni, C. (2017), "Workforce composition and innovation: how diversity in employees' ethnic and educational backgrounds facilitates firm-level innovativeness", *Journal of Product Innovation Management*, Vol. 34 No. 4, pp. 406-426, doi: 10.1111/jpim.12388.

Montoro-Sánchez, M.Á., Mora-Valentín, E.M. and Ortiz-de-Urbina-Criado, M. (2012), "Localización en parques científicos y tecnológicos y cooperación en I+ D+ i como factores determinantes de la innovación", *Revista Europea de Dirección y Economía de la Empresa*, Vol. 21 No. 2, pp. 182-190, doi: 10.1016/S1019-6838(12)70005-7.

Mushtaq, A., Haider, N. and Khan, M. (2015), "Work force diversity as a source of innovation in context of telecom sector in Pakistan", *Journal of Business and Management Research*, Vol. 8, pp. 205-216.

O'Brien, K. (2020), "Innovation types and the search for new ideas at the fuzzy front end: Where to look and how often?", *Journal of Business Research*, Vol. 107, pp. 13-24, doi: 10.1016/j.jbusres.2019.09.007.

Ostergaard, C.R., Timmermans, B. and Kristinsson, K. (2011), "Does a different view create something new? The effect of employee diversity on innovation", *Research Policy*, Vol. 40 No. 3, pp. 500-509, doi: 10.1016/j.respol.2010.11.004.

Parrotta, P., Pozzoli, D. and Pytlikova, M. (2014), "The nexus between labor diversity and firm's innovation", *Journal of Population Economics*, Vol. 27 No. 2, pp. 303-364, doi: 10.1007/s00148-013-0491-7.

Pletzer, J.L., Nikolova, R., Kedzior, K.K. and Voelpel, S.C. (2015), "Does gender matter? Female representation on corporate boards and firm financial performance – a meta-analysis", *Plos One*, Vol. 10 No. 6, doi: 10.1371/journal.pone.0130005.

Post, C. and Byron, K. (2015), "Women on boards and firm financial performance: a meta-analysis", *Academy of Management Journal*, Vol. 58 No. 5, pp. 1546-1571, doi: 10.5465/amj.2013.0319.

Quazi, A. and Talukder, M. (2011), "Demographic determinants of adoption of technological innovation", *Journal of Computer Information Systems*, Vol. 52 No. 1, pp. 34-42, doi: 10.1080/08874417.2011.11645520.

Quintana-García, C.and. and Benavides-Velasco, C.A. (2008), "Innovative competence, exploration and exploitation: the influence of technological diversification", *Research Policy*, Vol. 37 No. 3, pp. 492-507, doi: 10.1016/j.respol.2007.12.002.

Romero-Martínez, A.M., Montoro-Sánchez, A. and Garavito-Hernández, Y. (2017), "El efecto de la diversidad de género y el nivel educativo en la innovación", *Revista de Administração de Empresas*, Vol. 57 No. 2, pp. 123-134, doi: 10.1590/S0034-759020170202.

Sánchez, R., Diaz, Á. and Urbano, A. (2023), "Vertical segregation, innovation, and gender diversity in Spain's industrial sector", *Journal of the Knowledge Economy*, pp. 1-22, doi: 10.1007/s13132-023-01211-1.

Sastre, J.F. (2015), "The impact of R&D teams' gender diversity on innovation outputs", *International Journal of Entrepreneurship and Small Business*, Vol. 24 No. 1, pp. 142-162, doi: 10.1504/ijesb.2015.066154.

Solheim, M.C. and Herstad, S.J. (2018), "The differentiated effects of human resource diversity on corporate innovation", *International Journal of Innovation and Technology Management*, Vol. 15 No. 5, doi: 10.1142/S0219877018500463.

Srivastava, A. and Lee, H. (2005), "Predicting order and timing of new product moves: the role of top management in corporate entrepreneurship", *Journal of Business Venturing*, Vol. 20 No. 4, pp. 459-481, doi: 10.1016/j.jbusvent.2004.02.002.

Subramanian, A.M., Choi, Y.R., Lee, S.H. and Hang, C.C. (2016), "Linking technological and educational level diversities to innovation performance", *The Journal of Technology Transfer*, Vol. 41 No. 2, pp. 182-204, doi: 10.1007/s10961-015-9413-z.

Tajfel, H. and Turner, J.C. (2004), "The social identity theory of intergroup behavior", *Political Psychology*, pp. 276-293.

Talke, K., Salomo, S. and Kock, A. (2011), "Top management team diversity and strategic innovation orientation: the relationship and consequences for innovativeness and performance", *Journal of Product Innovation Management*, Vol. 28 No. 6, pp. 819-832, doi: 10.1111/j.1540-5885.2011.00851.x.

Teixeira, A.L., Oliveira, V.C.P., Mendes, P.S., Lopes, D.P.T. and Rapini, M.S. (2021), "Technological and organizational innovation for knowledge-intensive business services in Brazil", *Revista Brasileira de Inovação*, Vol. 20, p. e021002, doi: 10.20396/rbi.v20i00.8656133.

Teruel, M. and Segarra, A. (2017), "The link between gender diversity and innovation: What is the role of firm size?", *International Review of Entrepeneurship*, Vol. 15 No. 3, pp. 319-340.

Tonoyan, V. and Boudreaux, C.J. (2023), "Gender diversity in firm ownership: direct and indirect effects on firm-level innovation across 29 emerging economies", *Research Policy*, Vol. 52 No. 4, p. 104716, doi: 10.1016/j.respol.2022.104716.

Torchia, M., Calabrò, A., Gabaldon, P. and Kanadli, S.B. (2018), "Women directors contribution to organizational innovation: a behavioral approach", *Scandinavian Journal of Management*, Vol. 34 No. 2, pp. 215-224, doi: 10.1016/j.scaman.2018.02.001.

van Knippenberg, D. and Schippers, M.C. (2007), "Work group diversity", *Annual Review of Psychology*, Vol. 58 No. 1, pp. 515-541, doi: 10.1146/annurev.psych.58.110405.085546.

Wang, J., Yang, J. and Xue, Y. (2017), "Subjective well-being, knowledge sharing and individual innovation behavior: the moderating role of absorptive capacity", *Leadership and Organization Development Journal*, Vol. 38 No. 8, pp. 1110-1127, doi: 10.1108/LODJ-10-2015-0235.

Wei, L.Q. and Wu, L. (2013), "What a diverse top management team means: testing an integrated model", *Journal of Management Studies*, Vol. 50 No. 3, pp. 389-412, doi: 10.1111/joms.12013.

Xie, L., Zhou, J., Zong, Q. and Lu, Q. (2020), "Gender diversity in R&D teams and innovation efficiency: role of the innovation context", *Research Policy*, Vol. 49 No. 1, doi: 10.1016/j.respol.2019.103885.

Yang, Y. and Konrad, A.M. (2011), "Diversity and organizational innovation: the role of employee involvement", *Journal of Organizational Behavior*, Vol. 32 No. 8, pp. 1062-1083, doi: 10.1002/job.724.

Yoo, H.S., Jung, Y.L. and Jun, S.P. (2023), "The effects of SMEs' R&D team diversity on project-level performances: evidence from South Korea's R&D subsidy program", *R&D Management*, Vol. 53 No. 3, pp. 391-407, doi: 10.1111/radm.12575.

Zouaghi, F., García-Marco, T. and Martínez, M.G. (2020), "The link between R&D team diversity and innovative performance: a mediated moderation model", *Technological Forecasting and Social Change*, Vol. 161, p. 120325, doi: 10.1016/j.techfore.2020.120325.

About the authors

Adrian Testera Fuertes is a PhD student in business administration at the University of León.

Liliana Herrera is an Associate Professor at the University of León. Currently, her research is focused on dynamic processes of innovation and knowledge creation in firms, evaluation of innovation policies, the study of regional innovation systems and mobility of researchers. She has participated in several research projects financed by a broad range of institutions in Spain. Liliana Herrera is the corresponding author and can be contacted at: liliana.herrera@unileon.es