



# How does the COVID-19 economic crisis impact resilience? A configurational analysis of the spinoffs

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## Abstract

Spin-offs are companies with a high level of disruption that facilitate University-Society-Business knowledge transfer, promoting innovation and economic development of knowledge-based economies. On the other hand, globalization, climate change and anthropogenic pressure increase the probability of the appearance of community-transmitted pandemics between animals and people. In this context, the study of the conditions that facilitate resilience in companies with a high innovative content are important to guarantee long-term economic development. COVID-19 presents the appropriate conditions for carrying out an exploratory natural experiment that allows the identification, description, and analysis of conditions that facilitated the resilience of spin-offs promoted in a technological university. A database of spin-offs created before COVID-19 in the Universitat Politècnica de València was analyzed. A causal model was proposed and tested with fsQCA to identify the conditions that facilitate the business resilience of this type of startups with a high technological component that link areas of university research with the market. The proposed model defines resilience as the ability of a spin-off to withstand the impact of the shock, calculating differences of natural logarithms of sales in 2020 and 2019. The causal conditions used in the model are TMT Gender Diversity, the Distribution of Added Value to Workers and Ambidexterity (concerning Exploitation and Exploration). The results of this study show the necessary and sufficient conditions for the resilience to environmental shocks of spin-offs from a polytechnic university. This research offers promising lines of development for academics and suggests to policy makers ways to develop public-private initiatives and investment to improve business performance in crisis contexts. The results of this article offer practitioners a useful guide to design strategies that improve the resilience of these types of companies. This exploratory study based on case analysis makes it possible to identify design elements of the strategy that improve resilience before supply crises. A relevant contribution of this research is linked to its managerial implications in the design of strategies to improve resilience in crisis management. The lessons learned

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and the analysis of best practices can help improve the robustness of new spin offs in a context of crises caused by recurring pandemics.

**Keywords** Spin-off · Resilience · Strategy · Crisis · COVID-19

## Introduction

Knowledge-based economies are defined as economies that use knowledge as the basis for increased productivity and growth (Levie & Autio, 2008; Rim et al., 2019). Innovation occurs not only in the development of business activities but also in the ability to discover, evaluate and exploit the market's opportunities available to entrepreneurs (Shane & Venkataraman, 2000). Thus, innovation, in addition to improving company results, contributes to the economic well-being and wealth creation of a region or country (Braunerhjelm, 2011; Holcombe, 1998; Wennekers & Thurik, 1999). In this sense, most developed countries have economies that are in the innovation-driven stage (Porter, 1990), characterized by knowledge spillover, increased competition and the prevalence of diversity among prominent companies (Acs & Amorós, 2008). This allows flexibility and innovation in the economy, where the emergence of new companies is essential for technological improvement and innovation. One of the clearest examples of companies that are based on knowledge and innovation is the spinoff. Spinoffs are defined as "new companies that are a) based on the technology developed at the university, whereby b) that technology does not have to, but it can, be protected by patent or licence, while c) the technology developer may, but does not have to, be the entrepreneur who operates the company" (Mišić et al., 2018, pp.94, citing Goldstein et al., 2013). These companies play a fundamental role in improving regional innovation environments (Benneworth & Charles, 2005) and in knowledge economies by facilitating university-society-business knowledge transfer (Zucker et al., 1998). However, little research has been conducted on spinoffs (Clarysse et al., 2011; Narayanan et al., 2009).

However, since the Great Financial Crisis of 2008, various conjunctural crises have occurred, and the generalization of VUCA environments (volatile, uncertain, complex and ambiguous) has forced managers to engage in agile and accurate decision making (Bhattacharyya & Malik, 2020; Schoemaker et al., 2018) to survive. Consequently, management teams are forced to adjust their response mechanisms (Chen & Hambrick, 2012; Tangpong et al., 2015). Furthermore, the current context of globalization, climate change and anthropogenic pressure increases the probability of community-transmitted pandemics moving between animals and people (Morens & Fauci, 2020), which seems to increase the frequency with which economic, social, geopolitical and health conflicts take place (Castelló-Sirvent, 2023). Thus, it is unsurprising that the academic debate on resilience has become persistent and the level of academic interest is increasing.

In this paper, resilience is addressed as the degree of firm recovery following a shock (Buyl et al., 2019), where recovery is understood to be the ability

of a company to reach the level of sales it exhibited prior to the economic crisis following the declaration of the COVID-19 pandemic. In this sense, it is worth noting the specificity of this economic crisis since, unlike the GFC of 2008, this crisis also entailed a supply crisis derived from the lockdown mandates (Liu et al., 2021). As supply is reduced, spinoffs (mainly dedicated to B2B models) are more likely to reduce their sales, which merits an examination of this specific type of company. In this way, this study is intended to contribute to the literature on business resilience and is focused on the evaluation of response capacities and types to shocks to improve resistance and recovery (DesJardine et al., 2019; Duchek, 2020). Some studies indicate an asymmetric relationship between the levels of distribution of added value to employees and the ability to withstand economic shocks (Castelló-Sirvent, 2023). The literature points to an effect of organizational ambidexterity on the resilience of companies (Iborra et al., 2020; Luger et al., 2018), in which complementary returns between exploration and exploitation are obtained (Vahlne & Jonsson, 2017). In the same way, gender diversity in management teams has been identified as a casuistry that actually improves appropriate decision-making, since it takes advantage of improved communication, offers a broader range of perspectives and enables a more detailed critical analysis of problems (Milliken & Martins, 1996; Kirsch, 2018), which can improve the resilience of companies in crisis contexts. However, there is no research assessing the combined effect of these variables.

In this research, the behaviour of the spinoffs of the Universitat Politècnica de València (UPV) is studied since this university is one of the oldest in Spain, it was established in 1971, and it occupies the highest position among the Spanish polytechnic universities in the Academic Ranking of World Universities (ARWU) (2022), which is also known as the Shanghai Ranking. This ranking is considered internationally as the most prestigious indicator of universities in the world due to the objectivity of its methodology.

In an exploratory way, the combined effect of top management team (TMT) gender diversity, the distribution of value added to employees and the ambidexterity between exploitation and exploration is addressed in this research to understand the resilience of spinoffs produced through a technological university in facing the economic crisis caused by the coronavirus 2019 disease (COVID-19) pandemic.

The proposed model was tested using fuzzy set qualitative comparative analysis (fsQCA). This methodology is suitable for this research since it focuses on the study of cases, which makes it possible to identify common behaviour patterns, thus improving the understanding of the phenomenon under study (Rihoux & Lobe, 2009), enhancing understanding through factual analysis (Pinazo-Dallenbach & Castelló-Sirvent, 2023) and exemplifying an appropriate methodology for conducting exploratory studies (Beynon et al., 2021; Lei et al., 2022). A research design considering this background facilitates the development of empirical studies whose findings allow researchers to deepen the field of knowledge through the development of multilevel theory (Lacey & Fiss, 2009). This exploratory paper can serve as a starting point for designing future studies to deepen the knowledge extracted from this research. The main contribution of this research is the identification and delineation of the underlying profile patterns of the target spinoffs, which is intending to

guide managerial decisions for improving resilience in the face of economic shocks (Duchek, 2018).

In the following sections, a conceptual framework encompassing resilience and its importance in the actual context is provided. As part of the literature review, this research deepens our knowledge of value-added distributed to employees, ambidexterity between exploitation and exploration, and top management team gender diversity as factors affecting the resilience of firms. Subsequently, the fsQCA methodology is explained, the research results are presented, the main findings are discussed, and recommendations are provided. Finally, the conclusions, limitations of the study, and future research directions are presented.

## Theoretical development and propositions

### COVID-19 pandemic and company resilience

In December 2019, an outbreak of atypical pneumonia in Wuhan, China, attracted worldwide media attention (Hanaei & Rezaei, 2020). This was the starting point of the most severe health crisis of the twenty-first century, which was characterized by the global “lockdown” imposed as the only possible solution due to its rapid spread (Morens & Fauci, 2020). The COVID-19 pandemic was caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a previously unknown micro-organism (Lotfi & Rezaei, 2020) that could rapidly transmit between humans with relatively high morbidity and mortality rates (Morens & Fauci, 2020). The worldwide supply chain was quickly disrupted due to production stoppages and reductions in China (McKibbin & Fernando, 2021). This was the first point at which the pandemic affected the global economy. However, its effects would not take long to materialize (months later) in the form of a reduction in human capital, a reduction in GDP, the fall of stock markets, a reduction in tax revenue, and the delay of business activities, among others (Kolahchi et al., 2021). The impact on the economy caused global GDP to fall by 3.1% in 2020 (World Bank, 2023), which would come to be described as the worst recession since World War II. In Spain, the GDP fell by 11.3% in 2020 (World Bank, 2023), and during the period of strict confinement, the production of capital equipment fell by 57.8% and the production of durable consumer goods fell by 69% (Pinilla et al., 2021).

Thus, it is interesting to determine the different mechanisms companies leveraged to withstand this shock. From an etymological perspective, resilience comes from the Latin term *resiliens*, which refers to a setback or return action, thus it entails the perspective of a rebound or leap backwards (Iborra et al., 2020). From a strategic perspective, resilience includes the responses of organizations to changes in the environment, but it also refers to the responses of companies to critical events that impact their stability (Castelló-Sirvent, 2023). In this context, Buyl et al. (2019) defined resilience through two dimensions, namely, the ability to withstand the impact of a shock and survive and the ability to recover from such an impact. This article addresses resilience as a company’s ability to recover its prior sales levels after a shock, following previous works that estimate resilience by measuring

variations in economic-financial indicators (DesJardine et al., 2019; Iborra et al., 2020). The objective is to provide knowledge that may be useful for withstanding the increasingly frequent changes in the environment (Bhattacharyya & Malik, 2020) and that must be addressed through appropriate decision-making (Linnenluecke, 2017) and planning (Sullivan-Taylor & Branicki, 2011). In this sense, recent studies underline the importance of a dynamic response capacity to the implementation of transformational strategies to face increasingly recurrent structural and conjunctural changes (Chaturvedi & Karri, 2022; Haas, 2021; Laffranchini et al., 2022).

### Value-added distributed to employees

There are different ways of measuring the value-added generated by companies (Carton & Hofer, 2006). Value-added measurement systems can be classified on the basis of who is receiving the information, shareholders or other stakeholders (Lieberman et al., 2018). In this sense, the economic value-added (Stewart, 1991) stands out as a measure dedicated to shareholders. However, there is a way to measure value-added that offers interesting information for all stakeholders since it is based on the reevaluation of the information contained in a firm's annual accounts (Archel et al., 2018). The value-added statement (*Estado del Valor Añadido*<sup>1</sup> in Spanish) provides clear and intelligible information about the value-added or economic wealth generated during the process of production or the provision of services (Somoza López, 2016). The value-added is the increase in value of the inputs after the transformation carried out during the production or service process, according to the final value of the final outputs at market price (Castelló-Sirvent, 2023). In this research, this concept of value-added is adopted since it enables quantifying the economic value generated by a company during a particular period. In this sense, there are two ways of calculating it: subtractive and additive (Archel et al., 2018; Somoza López, 2016). This latter method addresses value-added as the sum of the income generated by the company and the distribution of this sum among the different production factors that were involved in its generation (Chatain & Mindruta, 2017; Priego-De-La-Cruz, 2020). The stakeholders among whom this value is distributed are employees, through wages and salaries, social charges and contributions to pension plans; partners, through dividends; creditors, through financial expenses; the company itself, through self-financing; and the state, through taxes (Archel et al., 2018; Castelló-Sirvent, 2023).

Spinoffs are established to explore and exploit innovation and knowledge (Ferreira et al., 2017). However, depending on the entrepreneurial stage in which such a firm is located, the weight of human capital on the cost structure may differ since, in early stages, the human team usually coincides with the founding team and/or the top management team (Colombo & Grilli, 2005; Shrader & Siegel, 2007). In the same way, the technology exploited can be more or less intensive in knowledge, increasing or decreasing human resource costs. These situations can vary the value-added distributed to employees.

Following the positionalist approach, the measurement of value-added makes it possible to analyse its appropriation by different stakeholders (Keohane, 2005;

Lange et al., 2022; Zeino-Mahmalat, 2008) in contexts of crisis or external shocks (Castelló-Sirvent, 2023), thus offering insight into the relationship between this appropriation and the success or failure of companies (Bacq & Aguilera, 2022; Castelló-Sirvent, 2023). The scarce literature shows opposite results regarding the role of employee appropriation (Castelló-Sirvent, 2023; Priego-De-La-Cruz et al., 2020), and there is no literature that analyses this issue among spinoffs.

In this exploratory study, the existence of a causal relationship between the value-added distributed to employees of UPV spinoffs and their resilience to the economic shock of 2020 are proposed.

## Ambidexterity

Organizational ambidexterity describes the ability of an organization to efficiently manage current business demands, which is known as an exploitation orientation, while simultaneously adapting to changes in the environment, which is known as an exploration orientation (Duncan, 1976). Another contribution of ambidexterity is the ability to use and refine existing knowledge (exploitation) while creating new knowledge to overcome the deficiencies or absences of knowledge that pertain to the execution of the work (exploration) (Turner et al., 2013). On the other hand, organizational ambidexterity has been defined more simply as the ability to simultaneously undertake exploitation and exploration (O'Reilly & Tushman, 2008), in which exploitation is related to refinement, efficiency, implementation, and execution and exploration is related to searching, risk-taking, experimentation, and innovation (Kassotaki, 2022).

In this way, exploitation and exploration involve fundamentally distinct and separable activities (He & Wong, 2004). While exploitation refers to the use of the company's existing capabilities, exploration implies the acquisition of new capabilities (Hill & Birkinshaw, 2014). Such separation requires diverse organizational and management approaches, ranging from organizational structure design elements to management practices, processes, and routines, and it includes organizational culture and beliefs (March, 1991). As a result, researchers have provided various guidance on how organizations can strike a balance between exploitation and exploration activities to address the conflicting requirements of exploitation and exploration (O'Reilly & Tushman, 2013; Turner et al., 2013), specifically in entrepreneurial firms (Parida et al., 2016).

The literature identifies different modes of ambidexterity and implicitly considers them to be mutually exclusive (Foss & Kirkegaard, 2020). Thus, the first recommended approach is the fostering of sequential or cyclical ambidexterity, which is achieved when organizations develop the ability to alternate, over time, periods of exploitation and periods of exploration, or vice versa. that is cyclical ambidexterity is achieved when both approaches are intertemporally balanced. (Duncan, 1976; O'Reilly & Tushman, 2008). The second approach is structural ambidexterity, which describes the adoption of an organizational structure with specific divisions dedicated to exploitation and exploration, thus allowing the simultaneous use of separate subunits (Hill & Birkinshaw, 2014). The third approach is contextual ambidexterity,

which places ambidexterity in the realm of the individual members of the organization, as supported by management models, and refers to the achievement of a balance between exploitation and exploration through the alignment of two opposite aspects within the same business unit (Gibson & Birkinshaw, 2004). Finally, the reciprocal ambidexterity approach implies the sequential search for ambidexterity among the independent units of the company, in which the results of exploration in one unit become resources for exploitation in another unit (Simsek et al., 2009).

On the other hand, research on organizational ambidexterity has focused primarily on large companies, and less attention has been given to small and medium-sized enterprises (SMEs), even though the latter form the main economic engine in any national or local economy (Kassotaki, 2022). However, we found research focused on the ambidexterity of SMEs, where it is noted that these companies (a) acquire knowledge through experience, seeking to improve their processes, systems and management skills as a way to balance and achieve high levels of exploitation and exploration (Iborra et al., 2022); (b) have the ability to identify and assess signs of change, question past explanations and challenge the status quo (O'Reilly & Tushman, 2008); (c) have the ability to detect relevant opportunities and threats, especially in dynamic markets, to achieve resilience (O'Reilly & Tushman, 2008); (d) have the ability to allocate resources differently to adapt to new opportunities and threats, move away from consolidated and known business models, and explore new perspectives that could present uncertain results (Iborra et al., 2020); (e) are capable of presenting options and making decisions that involve both risk and safety (O'Reilly & Tushman, 2008); and (f) capitalize on opportunities and engage in the kind of experimentation necessary to cultivate resilience. All this, even though ambidexterity is a capacity that requires time to develop (Iborra et al., 2020; Luger et al., 2018) becomes part of the dynamic capabilities of a company (O'Reilly & Tushman, 2008).

Regarding economic and financial crises, organizational ambidexterity has been identified as a fundamental construct that explains the resistance and continuity of companies (O'Reilly & Tushman, 2013) enabled by their ability to survive in situations of external crises (Linnenluecke, 2017). Likewise, it has been observed that companies must be effective in exploiting their current strengths in the short term while also exploring new strengths to take advantage of the future to ensure their survival and long-term success (Duncan, 1976). On the other hand, for SMEs to develop resilience, their ability to efficiently adapt to constantly changing environments through ambidexterity and strategic consistency is essential (Iborra et al., 2020).

Thus, it has been demonstrated that the capacity for organizational ambidexterity has positive and significant effects not only on organizational performance (Dolz et al., 2019; Gibson & Birkinshaw, 2004; He & Wong, 2004; Luger et al., 2018), innovation (He & Wong, 2004) and sales growth (He & Wong, 2004; O'Reilly & Tushman, 2013) but also on the survival of the company (Dolz et al., 2019; Hill & Birkinshaw, 2014; O'Reilly & Tushman, 2013). However, studies have shown that organizational ambidexterity strengthens the resilience of SMEs, enabling them to survive and recover from internal and external crises. This is because by integrating the conflicting demands for exploitation and exploration, SMEs are in an

advantageous position from which they can anticipate stressful disruptions, abrupt changes, and extreme events (Dolz et al., 2019). However, although it is difficult to achieve resilience (Linnenluecke, 2017), the capacity for ambidexterity can help to build resilience (Iborra et al., 2020).

In this vein, this exploratory study proposes the existence of a causal relationship between ambidexterity, which is understood as the simultaneous exploitation (EXPLOIT) and exploration (EXPLOR) of UPV spinoffs and their resilience to the economic shock produced in 2020.

## Gender diversity among top management teams

Resilient organizations manage to thrive in surprising, uncertain, often adverse, and generally unstable conditions (Lengnick-Hall et al., 2011). In this way, in the face of an adverse impact, the 2020 health crisis for example, organizations must possess resilience, which is obtained through the strategic management of the organization's human resources to ensure the skills necessary for the organization to appropriately respond to the impact (Lengnick-Hall et al., 2011).

Teams are fundamental and indispensable elements of modern organizations (Patrício & Franco, 2022). TMTs have been defined as the "executives accountable to the CEO who meet regularly to develop organizational strategy and oversee its implementation" (Krause et al., 2022, p. 1570). Therefore, this definition excludes the CEO from the members of the TMT, making it clear that this team works for the CEO (Krause et al., 2022). Likewise, the literature suggests that to leverage the complementary skills and behaviours that empower an organization to face adversities, the workforce must be sufficiently diverse (Kim et al., 2021) such that the process and capacities underlying organizational resilience can be improved (Duchek et al., 2020). In this sense, Talke et al. (2011) also claimed that the fundamental premise is that diversity should generate a positive impact on effectiveness of strategic planning and the consequent outcomes, especially in highly complex situations that require diverse perspectives that are missing from homogeneous teams.

In this regard, upper echelon theory, developed by Hambrick and Mason (1984), represents an approach commonly taken in the literature on diversity and its organizational impact. This theory holds that the leadership of the TMT influences the processes and performance of an organization through its demographic and psychological characteristics, seniority in the organization, and employment history, thus impacting organizational outcomes Hambrick & Mason, 1984).

Therefore, the decision-making skills necessary for SMEs to detect changes in their environment and take advantage of exploration and exploitation opportunities are based on the diversity of the TMT (Dolz et al., 2019). The influence of diversity may be greater in complex critical situations (Duchek et al., 2020), so the impact of diversity in reinforcing organizational resilience has also been addressed in the crisis management literature (Kim et al., 2021).

In the organizational context, studies on diversity have used different terms, such as heterogeneity, dissimilarity, or dispersion, to refer to this concept (Harrison & Klein, 2007). To clarify the meaning of these variants, diversity has been defined in



the literature as the distribution of personal attributes among interdependent members of a work unit (Jackson et al., 2003). Likewise, diversity has been classified into different categories that have become quite relevant since visible disparities can trigger reactions based on prejudice and previous experiences (Duchek et al., 2020).

Thus, diversity is categorized as observable diversity, such as the demographic characteristics of the groups, and underlying or nonobservable diversity, such as differences in values, skills, and knowledge, or cohort membership (Milliken & Martins, 1996). Other authors have ignored these dimensions of diversity and have worked on what they have called “diluted” diversity (Duchek et al., 2020; Jackson et al., 2003). On the other hand, the effect of diversity in workgroups, on workgroup performance (Horwitz & Horwitz, 2007), organizational outcomes (Glick et al., 1993; Rodríguez-Fernández et al., 2020), and on both (Duchek et al., 2020) have been examined in the literature. In this research, gender diversity is understood as referring to female representation in top management teams (Egerová & Nosková, 2019).

Regarding the extant studies on gender diversity in TMTs, a great majority of the research has been conducted from the perspective of upper echelon theory (Hambrick & Mason, 1984), as the authors have highlighted the importance of demographic characteristics in TMT decision-making. However, that research has been heterogeneous regarding the type and direction of in the impact of diversity on the organization.

In this way, Almor et al. (2022) claimed that gender diversity in TMTs can increase ambidexterity over time by fostering both exploitative and exploratory organizational behaviour, and Singh and Sinha (2023) concluded their study by noting the significant, but often overlooked, role of women in fostering organizational ambidexterity. Perryman et al. (2016) found that companies with greater TMT gender diversity face lower risk and offer better performance. Conyon and He (2017) also found a positive correlation between gender diversity and performance. The findings of Luanglath et al. (2019) indicate that the demographic characteristics of TMT members, such as gender, can influence TMT processes, which in turn relates to increased productivity. Ruiz-Jiménez and Fuentes-Fuentes (2016) concluded that the presence of gender diversity in the TMT positively moderates the relationship between management skills and performance in product and process innovation.

The literature is also focused on the proportion of women in TMTs. Regarding organizational policies mean to promote the inclusion of gender diversity in TMTs, empirical evidence reveals that the greater the representation of women in TMTs is, the greater the organization’s performance (Krishnan, 2009) and the more positive the impact on company sales, which improves economic results (Rodríguez-Fernández et al., 2020). Likewise, gender diversity is positively associated with the financial performance of the company once a critical mass has been achieved, which is estimated to be between 31 and 40% of female TMT membership. Although a linear relationship is not supported, or only partially supported, a curvilinear U-shaped relationship is found between the number of women in the TMT and financial performance (Egerová & Nosková, 2019). Similarly, companies with more women in management positions experience better results in terms of both market performance and the return on their corporate assets (Terjesen et al., 2016).

Based on the discussion presented above, the existence of a causal relationship between the TMT gender diversity (TMTGDIV) of UPV spinoffs and their resilience to the economic shock produced in 2020 is proposed in this exploratory study.

This theoretical framework enables the formulation of the following causal model for understanding the business characteristics that facilitate (and hinder) the resilience of spinoffs:

$$\text{RES} = f(\text{VADE}, \text{EXPLOIT}, \text{EXPLOR}, \text{TMTGDIV})$$

Adopting a joint configurational approach to causal conditions and based on the theoretical framework reviewed in this article, the following propositions are stated:

- P1. None of the four causal conditions (VADE, EXPLOIT, EXPLOR, TMTGDIV) are necessary to predict resilience (and nonresilience) among UPV spinoffs.  
 P2. The four causal conditions form multiple configurations that are sufficient for predicting resilience and nonresilience among UPV spinoffs.

## Data and methods

Information from the R&D and Transfer Area of the Polytechnic City of Innovation Foundation (Universitat Politècnica de València) regarding the UPV spinoffs that were created before 2019 is used in this study. To analyse the focal spinoffs (N=14), the Iberian Balance Analysis System (SABI<sup>®</sup>) database of Bureau van Dijk (BvD) was used. SABI<sup>®</sup> offers economic-financial and commercial information on 2,900,000 Spanish and 900,000 Portuguese companies. The information in SABI comes from the annual accounts deposited in the Mercantile Registry.

The economic data of the spinoffs were obtained, forming a complete database for the study. Likewise, the Bureau Van Dijk ORBIS<sup>®</sup> database was used to determine the number of patents registered for each spinoff and the structure of the TMTs. Using differences of natural logarithms to construct the dependent variable is a recommended methodological alternative in economics (Coad, 2007) and management (Iborra et al., 2020). Thus, resilience (RES) is calculated as the difference between the natural logarithms of total net sales in the year of the crisis (2020) and the immediate previous year (2019) ( $\text{RES}_{20-19}$ ).

A resilient spinoff exhibits the ability to reduce the impact of a crisis. Nonresilient spinoffs suffer a greater impact from external shocks. According to Priego-De-La-Cruz et al., (2014, 2020), the value-added distributed to employees (VADE) is taken as the proportion of value captured by employees in comparison to the total value added generated by the company in 2019, prior to the crisis. Following previous studies in measuring ambidexterity (Iborra et al., 2020), exploitation (EXPLOT) is taken as a proportion of labour cost to net sales in 2019. On the other hand, exploration (EXPLOR) is identified as patents registered by a spinoff through 2019. The variable is coded dichotomously, taking a value of 0 when the spinoff had no registered patents and of 1 otherwise. Finally, similarly, the top management team gender

**Table 1** Conditions studied and methods of calculation

Condition	Method of calculation
RES <sub>20</sub>	Ln(NS <sub>20</sub> ) – Ln(NS <sub>19</sub> )
VADE <sub>19</sub>	LABC/VA
EXPLOIT <sub>19</sub>	LABC <sub>19</sub> /NS <sub>19</sub>
EXPLOR <sub>19</sub>	No patents = 0; patents = 1
TMTGDIV <sub>19</sub>	No women = 0, women = 1

Source: Own elaboration

diversity (TMTGDIV) variable takes a value of 1 when the spinoff had one or more women on its management team in 2019 and 0 otherwise.

Table 1 shows the conditions analysed and their calculation method. Appendix 1 presents a glossary of the terms and abbreviations used in this study.

Thus, the proposed model is  $RES_{20} = f(VADE_{19}, EXPLOIT_{19}, EXPLOR_{19}, TMTGDIV_{19})$ .

The fuzzy set qualitative comparative analysis (fsQCA) methodology was developed by Charles Ragin (1987, 2009) from Boolean logic. It is recommended for small samples (Fiss, 2011; Marx, 2006; Ragin, 2009; Woodside, 2013) and can be used under certain model characteristics with fewer than 15 observations (Marx, 2006). This methodology has been widely used in the social sciences. Its development has been incremental in the areas of business knowledge and management. fsQCA focuses on the study of cases and contributes to improving the understanding of factors that are determinants of a specific result. The factual knowledge of the researchers (Chang & Cheng, 2014) allows us to enrich the case study and extend the implications of the study. The most relevant points to consider in using the methodology are listed below. For a more detailed description of the fsQCA methodology, see the study by Pappas and Woodside (2021).

First, the analysed data variables, which in fsQCA terminology are called conditions, must be calibrated. This step transforms the raw data into fuzzy set-fit scores (Ragin, 2009; Woodside, 2013) according to new values that fall between 0 and 1. Calibration can be performed according to fixed values for three points (full inside, maximum ambiguity or full outside) and can also be performed according to percentiles. Following Pappas and Woodside (2021), percentiles are used in this study, establishing as thresholds the cut-off points of the 95th, 50th and 5th percentiles for the full-in, maximum ambiguity, and full-out points, respectively. Dichotomous variables are considered according to their own inclusion (or noninclusion) criteria.

In the fsQCA methodology, a necessity analysis is conducted for the presence and absence of the outcome studied (in this research, the resilience of the spinoffs). The necessity analysis reveals whether it is necessary for one or more conditions to occur for the target phenomenon to occur. FsQCA assesses the sufficiency between the result and various possible sets of condition configurations (Mendel & Korjani, 2012), as researchers can identify which causal conditions may be necessary and/or sufficient to account for the occurrence of the focal result. A sufficiency analysis is then carried out, showing the combinations of conditions that give rise to the

phenomenon studied. To do this, a "truth table" is built, integrating all the different condition combinations that could occur (Schneider & Wagemann, 2012). The factual analysis and the thresholds determined for proportional reduction in inconsistency (PRI) (Pappas & Woodside, 2021) make it possible to establish the cases that are included in the solution to the proposed model. In this sense, although there are three solutions to the model in a sufficiency analysis (complex, parsimonious and intermediate solutions), the best practices in fsQCA (Pappas & Woodside, 2021) suggest using the intermediate solution to improve the analysis and interpretation of the results (Ragin, 2009).

FsQCA allows the identification of asymmetric relationships and connections that can be missed when using conventional statistical methodologies. According to Thomann and Maggetti (2020), fsQCA enables a deeper understanding of cases by taking a factual approach and a better detection of the asymmetric relationships between cases (Woodside, 2013).

Appendix 2 reports the main economic and financial magnitudes of the spinoffs analysed. The companies analysed are concentrated in three sectors (IT and Communications, Consulting Services and Materials and Nanotechnology), with a large number of spinoffs oriented towards IT and Communications. The spinoffs included in this study generated 148 jobs in 2019. The average age of the companies was 9 years, with a minimum experience of 4 years and a maximum of 15 years. The foundation dates of the focal spinoffs were between 2005 and 2016, and most of the companies were recognized as UPV spinoffs several years after their foundation. In 2019, before the crisis, the focal companies generated net sales of 11,571 million euros. In 2020, with the impact of the external shock caused by COVID-19, the total volume of net sales suffered a sharp decline (-9,8%), falling to a total of 10.432 million euros. The resilience at the beginning of the crisis, expressed in absolute economic values, was negative, causing the set of spinoffs a reduction of 1,139 million euros in net sales.

The fs/QCA 4.0 software was used in this research (Ragin & Davey, 2014). Table 2 shows the conditions used and their calibration points. According to the percentile-based method, three cut-off points were used (full in: 0.95; maximum ambiguity: 0.5; full out: 0.05).

## Results and discussion

Evidence suggests that the spinoffs reacted heterogeneously to the crisis based on their conditions before the COVID-19 shock occurred. The results reveal both resilient (RP) and nonresilient (NRP) profiles. Table 3 presents the results of the necessity analysis for both outcomes.

According to the model tested with fsQCA, there are no necessary conditions for the prior configuration of the crisis management strategies of the focal spinoffs, either in the resilience and nonresilience analysis. No condition presents consistency levels of higher than 0,9 (Ragin, 1987, 2009). Appendix 3 shows the list of spinoffs analysed and the patterns identified in their archetypes, according to their situations before the COVID-19 crisis.

**Table 2** Model conditions, statistics and calibration

Conditions	Calibration			Descriptive statistics				
	Full-in	Max.A	Full-out	Max	Min	Average	St. Dev	Median
RES <sub>20</sub>	2,37	0,32	-2,22	2,86	-3,74	0,13	1,53	0,32
VADE <sub>19</sub>	0,98	0,78	0,43	1,00	0,38	0,76	0,19	0,78
EXPLOIT <sub>19</sub>	8,72	0,77	0,16	16,55	0,09	2,24	4,27	0,77
EXPLOR <sub>19</sub>	1		0					
TMTGDIV <sub>19</sub>	1		0					

Following fsQCA best practices (e.g., Pappas & Woodside, 2021), The point of maximum ambiguity was established at the 50th percentile. As a consequence, the threshold values of the two phenomena studied (presence and absence of resilience) are set at values different from zero, given that the thresholds are established according to the distribution of cases. As a consequence, values greater than zero may occur in RES<sub>20</sub> (e.g. 0,31) but are part of the absence

Source: Own elaboration

The exploratory approach taken in this research did not set any directional expectations prior to obtaining solutions from the proposed model. The results suggest that the resilient spinoffs show two differentiated strategies that reinforced their strategic characteristics during the period prior to the shock (2019), enabling a robust response that allowed them to react to the external shock in an agile manner in 2020, more effectively recovering their previous sales levels. Similarly, other spinoffs used two strategies that proved to be nonresilient during the crisis. Specifically, according to the intermediate solution to the model, Table 4 shows the characteristics of spinoffs prior to the crisis (2019) enabled resilience during the crisis (2020).

The profile strategies leveraged for dealing with the economic crisis explain the strong resilience of companies such as ADVANCED WAVES SENSORS SL, VERATECH FOR HEALTH SL and MICROBIOTECH SL. In addition, Table 3

**Table 3** Necessity analysis. The resilient and nonresilient profiles of spinoffs

	Resilient Profiles (RP)		Nonresilient Profiles (NRP)	
	Consistency	Coverage	Consistency	Coverage
VADE <sub>19</sub>	0,595	0,529	0,782	0,737
~VADE <sub>19</sub>	0,704	0,752	0,500	0,567
EXPLOIT <sub>19</sub>	0,733	0,811	0,551	0,647
~EXPLOIT <sub>19</sub>	0,681	0,589	0,840	0,769
EXPLOR <sub>19</sub>	0,190	0,431	0,237	0,569
~EXPLOR <sub>19</sub>	0,810	0,500	0,763	0,500
TMTGDIV <sub>19</sub>	0,190	0,431	0,237	0,569
~TMTGDIV <sub>19</sub>	0,810	0,500	0,763	0,500

Source: Own elaboration

**Table 4** Sufficient analysis for resilient and nonresilient profiles

	Resilient Profiles (RP)		Nonresilient Profiles (NRP)	
	RP <sub>1</sub>	RP <sub>2</sub>	NRP <sub>1</sub>	NRP <sub>2</sub>
VADE <sub>19</sub>	X	O	X	X
EXPLOIT <sub>19</sub>	X	X		O
EXPLOR <sub>19</sub>	O	X	X	O
TMTGDIV <sub>19</sub>	O	X	X	O
Profile	0,496	0,139	0,216	0,542
Raw coverage	0,496	0,139	0,216	0,542
Unique coverage	0,899	0,973	1	0,957
Consistency				
Intermediate solution	0,635		0,757	
Coverage	0,915		0,969	
Consistency	0,653		0,862	
PRI				

Following Fiss (2011), X indicates the presence of a condition, white circles indicate its absence, and blank spaces indicate "do not care"

Source: Own elaboration

shows the characteristics of the nonresilient spinoffs in 2020 prior to the crisis (in 2019), explaining companies such as QUATECHNION SL, DAS PHOTONICS SL, ICADOS INNOVACION Y TECNOLOGÍA SL, EXOS SOLUTIONS SL and TITANIA SERVICIOS TECNOLÓGICOS SL.

The analysis of the resilient profiles (RP) shows sufficient levels of coverage (0,635) and consistency (0,915), which are both higher than the standards set by the best practices in fsQCA (consistency > 0,75; coverage > 0,25) (Ragin, 1987, 2009).

RP<sub>1</sub> has a coverage of 49,6% and shows the characteristics of two spinoffs (see Appendix 3) that achieved high resilience during the 2020 crisis, and in 2019, prior to the impact of COVID, exhibited high value-added distributed to employees, had teams without gender diversity, and had oriented their strategies towards exploitation rather than exploration. These companies with a greater orientation towards exploitation were trained and prepared to carry out rapid readjustments in their business models during the crisis via productivity (via the performance ratio of employees to sales), since they had a greater propensity towards the exploitation of resources than towards general exploration. In this causal configuration, the value added to employees does not affect resilience when it is combined with high levels of productivity. This finding partially contradicts the results of previous studies (Linnenluecke, 2017; O'Reilly & Tushman, 2013) regarding the important role of ambidexterity in the resilience of organizations, but the factual evidence identified adds an interesting perspective on the combined effects of the distribution of value added to employees and a strongly exploitation-oriented strategy.

RP<sub>2</sub> has a coverage of 13,8% and exhibits another resilient spinoff characteristic. This solution explains the profile of one company (see Appendix 3). The characteristics of this company improved its resilience in an alternative way to those reported in the RP<sub>1</sub> solution of the proposed model. In this case, the TMT was gender diverse,

including at least one woman, and demonstrated high levels of organizational ambidexterity, given that in 2019, it had oriented its strategy towards both exploitation and exploration. In addition, this company diversified its sources of value creation since the absence of the VADE<sub>19</sub> condition suggests that value generation was supported by other stakeholders (e.g., creditors, shareholders, and company self-financing). A detailed analysis shows that the distribution of added value among the stakeholders skewed towards stakeholders other than the employees, since with the arrival of the crisis, it had a greater margin with which to readjust its strategy toward greater resilience.

This result suggests that the archetypes configuring the determinants of resilience in spinoffs are defined by their ambidexterity (RP<sub>2</sub>), or their orientation towards exploitation (RP<sub>1</sub>). In this sense, the orientation towards exploration only works in combination with exploitation under an ambidexterity strategy, which is in line with previous studies indicating that organizational ambidexterity allows detecting and leveraging new opportunities through the reallocation of organizational resources (O'Reilly & Tushman, 2013). Thus an exploitation orientation has a positive impact on companies, facilitating their survival and recovery and thus their resilience in the face of a crisis (Iborra et al., 2020).

Likewise, this result shows two paths depending on the type of management team at play. On the one hand, resilient spinoffs with TMT gender diversity are ambidextrous. This finding is consistent with previous studies that argue that gender diversity in TMTs has positive effects on organizational ambidexterity and fosters long-term R&D processes and innovation in the organization. In this way, organizations with TMT gender diversity are prevented from making hasty decisions in the short term that compromise the organization's survival in the long term (Almor et al., 2022). The available evidence suggests a path for the development, extension and replication of these results in the context of spinoff to obtain new conclusive evidence by following the approach of previous studies that have highlighted the relevance of gender diversity in the TMT of different types of companies (Ali & Konrad, 2017; Saeed et al., 2021). On the other hand, resilient spinoffs with no TMT gender diversity are oriented towards exploitation. In the same way, the available evidence suggests that low levels of value distribution to employees can help to improve the resilience of spinoffs when combined with ambidexterity capability (RP<sub>2</sub>). However, when combined with a strong exploitation orientation, the negative effect of the value-added distributed to employees is inhibited (RP<sub>1</sub>).

The analysis of nonresilient profiles (NRP) shows adequate levels of coverage (0,757) and consistency (0,969), which are both higher than the standards set by the best practices in fsQCA (consistency > 0,75; coverage > 0,25) (Ragin, 1987, 2009).

In an analysis prior to the crisis,, the spinoffs that did not demonstrate resilience to the impact of the shock in 2020 showed specific profiles in 2019 that conditioned them in the crisis management process they applied in 2020. NRP<sub>1</sub> has a coverage of 21.6% and shows the combination of conditions that did not lead to resilience success during the COVID-19 crisis. The spinoffs that showed this archetype (see Appendix 3) were led by TMTs lacking in gender diversity and, before the crisis, offered a high distribution of added value to their employees, remaining clearly oriented towards exploration. In 2019, the employees of these companies were

stakeholders that managed to capture more value than those of the rest of the companies analysed.  $NRP_2$  has a coverage of 54,1% and shows another combination of conditions that led to the failure to recover during the crisis. Unlike the companies that showed  $NRP_1$ , these companies (see [Appendix 3](#)) included women in their TMT prior to the crisis, offered a high distribution of added value to their employees and did not adopt ambidextrous strategies since they were not particularly oriented towards either exploitation or exploration. Gender diversity in TMTs fails to reverse the effects of a combination of high added value distributed to employees, the absence of patents, and the low productivity levels of spinoffs.

The findings are aligned with the methodological approaches of previous studies on business agility (Bueno Campos et al., 2019; Datti & Kuppusamy, 2023; Saputra et al., 2022). The findings of this research support causal relationships linking lower levels of value-added captured by employees with greater levels of resilience to shocks. This result is consistent with previous research on the role of employees in company bankruptcies (Priego-De-La-Cruz et al., 2020). This result extends preliminary analyses of a field of study characterized by little-studied relationships (Castelló-Sirvent, 2023). It is verified that high levels of appropriation weaken strategic agility in business crisis situations. In this sense, the findings offer a guide for practitioners in managing the distribution of added value among stakeholders. Negotiation between the different stakeholders prior to the crisis represents an element of strategic design that contributes to strengthening the resilience of spinoffs during crises. However, this evidence offers granularity to the academic literature in this field. The causal relationships analysed show that the orientation towards exploitation assumes high levels of value-added distributed to employees without a decrease in resilience in the case of the spinoffs analysed. From the perspective of ambidexterity analysis, the strategic profiles of spinoffs that are characterized by their ambidexterity show robustness in the face of crises. An exploration-intensive strategic orientation is causally linked to nonresilient spinoffs during the crisis. Similarly, the absence of exploitation and exploration limits the strategic options available to TMTs in crisis management.

This research relates to previous studies on the identification of resilient profiles in Start-Up (Haase & Eberl, 2019), particularly during the COVID-19 crisis (Sreenivasan et al., 2023), according to the agility of these organizations (Kuckertz et al., 2020) and its effects on performance (Hadjielias et al., 2022; Mota et al., 2022) and financial resilience (Sreenivasan & Suresh, 2023). The available evidence connects the research to future research. Scholars will be able to link the method of this study with the Theory of Planned Behavior (TPB) of spinoff entrepreneurs and the conditions that ensure their perseverance and resilience (Steinbrink & Ströhle, 2023).

### **Robustness and internal reliability**

Following the best practices in fsQCA (Pappas & Woodside, 2021) and the methodology proposed by Paykani et al. (2018), a stress test of the model was carried out by recalibrating the conditions. According to Stevens (2016) and Fiss (2011), the



new calibration applied to the studied attributes modifies the full-inside (−10%) and full-outside (+ 10%) points, resulting in the following thresholds: full-inside (15%), maximum ambiguity (50%) and full-outside (85%). Next, the proposed model was run again using fsQCA, and the results obtained for the intermediate solution were consistent with those prior to the stress test. The intermediate solution to the model resulted in the same two profiles for the resilient spinoffs and the same for the non-resilient spinoffs. The consistency levels after performing the stress test were adequate according to the best practices in fsQCA (consistency > 0,75; coverage > 0,25) (Ragin, 1987, 2009), both for the presence and absence of the outcome (Resilient spinoffs: Consistency: 0,844; Coverage: 0,428; Nonresilient spinoffs: Consistency: 0,994; Coverage: 0,654).

## Conclusions

The objective of this research is identifying the central characteristics that act to preserve business resilience under external shocks. The analysis is focused on the spinoffs of the Universitat Politècnica de València (Spain). The main novelty of this study is the identification of the precrisis characteristics of the most resilient spinoffs. Likewise, the archetypes that lead to nonresilience are revealed. Some managerial implications of this research involve presenting the prior profiles of companies that improve their crisis management. Based on the findings of this research, managers have the opportunity to design strategic itineraries that strengthen and protect their companies in a VUCA environment where external shocks are increasingly frequent. According to the study, the directors of universities and knowledge transfer services, as well as the researchers who participate in university spinoffs and the practitioners integrated into their TMTs, can identify the best practices for preparing spinoffs for crisis management. The resilient spinoffs show an ambidextrous strategic orientation or are strongly linked to exploitation prior to the crisis. Likewise, the findings reveal an inverse causal relationship between the capture of added value by employees and the resilience of spinoffs. However, this study offers a new perspective for the analysis of business archetypes and enables extending the academic debate on the effects of the combination of high distribution of value added to employees and strongly exploitation-oriented strategies. In addition, when a spinoff has low productivity and no patents or focuses its strategy solely on exploration, the evidence shows that the strategic options available to the TMT in crisis management are limited. An important contribution of this research is a novel study on the gender configuration of TMTs in spinoffs. The gender diversity of TMTs in combination with other conditions should be further studied, given that the diversity of TMTs is presented as an attribute whose effect is moderated depending on the conditions with which it is combined.

This article applies a case study-focused methodology that is suitable for small datasets. The specific characteristics of the sample studied represent a reference for polytechnic universities, although future researchers should extend the proposed model to the study of other spinoffs and other economic crises. Future research should extend these findings and test the proposed business resilience model,

expanding the sample to include spinoffs from other polytechnic universities and the Spanish university system as a whole. A promising line of research involves studying how the proposed model can be generalized by including other internal contingent elements, such as sectoral crises or the intrinsic problems of the focal companies. This study is not without limitations. The research is based on the use of secondary data sources. In this sense, to overcome this limitation, future research should analyse the behaviour of the sector, and the focal spinoffs through case study approaches, use other secondary data sources and add other primary sources, such as expert analysis or interviews with managers. From a methodological point of view, a future line of research is the establishment of the cut-off point for recovery (resilience) above (or below) zero, maintaining the usual points for full inside (95%) and full outside (5%). This approach could be useful in future research that analyses outcomes expressed in the absolute variation between two moments.

An interesting path of development would enable the creation of new theories from a multilevel approach, offering scholars an improved understanding of the connection between the micro and meso levels on the one hand and the meso and macro levels on the other hand. Future research can focus its analysis and formulation of recommendations on providing guidance to policy-makers during the process of designing public policies for university-society knowledge transfer.

## Appendix

### Appendix 1. Glossary

Term	Description
EXPLOIT <sub>19</sub>	Exploitation in 2019
EXPLOR <sub>19</sub>	Exploration in 2019
LABC <sub>19</sub>	Labor cost in 2019
NS <sub>19</sub>	Net sales in 2019
NS <sub>20</sub>	Net sales in 2020
RES <sub>20</sub>	Resilience in 2020
TMTGDIV19	Top Management Team Gender Diversity in 2019
VA <sub>19</sub>	Value-Added in 2019
VADE <sub>19</sub>	Value-Added Distributed to Employees in 2019
W19	Number of employees in 2019

**Appendix 2. Main economic and financial magnitudes of the spin-offs analyzed****Table 5** List of spin-offs analyzed

Spin-off	NIF	Sector	Foundation	UPV spin-off	NS <sub>19</sub>	NS <sub>20</sub>	RES <sub>20</sub>	W <sub>19</sub>
DAS PHOTONICS SL	B97623938	IT and Communications	2005	2008	8.266	6.789	-1.477	75
ADVANCED WAVES SENSORS SL	B98199136	IT and Communications	2009	2012	221	483	262	12
INGENIERÍA DE PRESAS SL	B98323850	Consulting Services	2011	2011	396	570	174	2
FENT INNOVATIVE SOFTWARE SOLUTIONS SL	B98245780	IT and Communications	2010	2012	249	441	192	7
VERATECH FOR HEALTH SL	B98309511	IT and Communications	2010	2011	153	205	52	6
CALCULO Y ESTRUCTURAS SENSADAS SL	B98559420	IT and Communications	2013	2013	217	422	205	1
SOLVER MACHINE LEARNING SL	B98871080	IT and Communications	2016	2016	288	405	117	7
ICADOS INNOVACION Y TECNOLOGÍA SL	B85006088	IT and Communications	2007	2011	554	312	-242	6
EXOS SOLUTIONS SL	B98596174	Consulting Services	2013	2013	257	236	-21	6
KUMORY SYSTEMS SL	B98684624	IT and Communications	2014	2014	11	192	181	4
VLC PHOTONICS SL	B98366859	Materials and Nanotechnology	2011	2011	760	187	-573	13
TITANIA SERVICIOS TECNOLÓGICOS SL	B97905749	IT and Communications	2007	2011	103	90	-13	2
QUATECHNION SL	B98499395	IT and Communications	2012	2017	84	2	-82	5
MICROBIOTECH SL	B98492358	IT and Communications	2012	2016	12	98	86	2

Economic magnitudes (net sales of 2019 and 2020, and resilience) expressed in thousands of euros

### Source: Own elaboration Appendix 3. Spin-offs analyzed and profiles for resilience and non-resilience

Spin-off	RP <sub>1</sub>	RP <sub>2</sub>	NRP <sub>1</sub>	NRP <sub>2</sub>	Non supported*
DAS PHOTONICS SL			✓		
ADVANCED WAVES SENSORS SL	✓				
INGENIERÍA DE PRESAS SL					✓
FENT INNOVATIVE SOFTWARE SOLUTIONS SL					✓
VERATECH FOR HEALTH SL	✓				
CALCULO Y ESTRUCTURAS SENSADAS SL					✓
SOLVER MACHINE LEARNING SL					✓
ICADOS INNOVACION Y TECNOLOGÍA SL				✓	
EXOS SOLUTIONS SL				✓	
KUMORY SYSTEMS SL					✓
VLC PHOTONICS SL					✓
TITANIA SERVICIOS TECNOLÓGICOS SL				✓	
QUATECHNION SL			✓		
MICROBIOTECH SL		✓			

Cases not supported by the proposed model. Based on the available sample, these spin-offs do not fit any identified profile (RP<sub>1</sub>, RP<sub>2</sub>, NRP<sub>1</sub>, NRP<sub>2</sub>), representing the difference between 1 and full model coverage according to fsQCA standards

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**Code availability** The data analysis was carried out using fsQCA 3.0 software.

## Declarations

**Conflicts of interest/competing interests** The authors have no conflicts of interest to declare that are relevant to the content of this article.

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