





Opportunity recognition in academic spin-offs: a contingency approach

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This paper analyses the factors that influence opportunity recognition (OR) of academic spin-offs (ASOs) from a contingency perspective. We focus on factors linked to the academic entrepreneur and propose that their relevance for explaining OR in ASOs depends on the context in which these firms operate: discovery (the necessary information for entrepreneurs to assess the new opportunities is available in the market) versus creation (complete information about opportunity exploitation and the likelihood of achieving certain outcomes is not available in the market). Results obtained in a sample of 167 Spanish ASOs show that, in a discovery context, academic entrepreneurs' OR is positively related to entrepreneurial self-efficacy, previous managerial experience and access to academic and industry networks. In a creation context, only entrepreneurial self-efficacy and access to industry networks become critical to OR, whereas previous managerial experience exerts a negative effect. Our results also show that the most relevant factor in a discovery context is previous managerial experience, while in a creation context, entrepreneurial self-efficacy is the most significant.

1. Introduction

Academic spin-offs (ASOs) have received increasing attention from researchers and policymakers as a catalyst of the innovation system in most countries (Siegel and Wright, 2015).

Most studies acknowledge the relevance of opportunity recognition (OR) as a key capability of academic entrepreneurs but fail to address how they

recognise opportunities and what factors affect OR (Mira-Solves et al., 2021). The analysis of OR constitutes a relevant gap in the literature on academic entrepreneurship because: (i) understanding OR has become the most important issue in the field of entrepreneurship and is considered the core of the entrepreneurial process (Shane, 2003; George et al., 2016; Mohammadi and Heshmati, 2021); (ii) the study of OR in ASOs is particularly relevant, since academic

entrepreneurs experience major difficulties in recognising opportunities because they often lack market knowledge, experience and networks (Khodaei et al., 2022; Tagliazucchi and Marchi, 2022).

The entrepreneurship literature has traditionally addressed the study of OR from two perspectives: discovery and creation (Álvarez and Barney, 2007; Smith et al., 2019). The discovery perspective argues that opportunities are real and objective phenomena that exist independently of the actions of entrepreneurs and are waiting to be discovered (Álvarez and Barney, 2007). The creation perspective claims that opportunities do not exist *ex ante* as an objective phenomenon, but they are constructed by the entrepreneur (Alvarez and Barney, 2010; Henderson and Graebner, 2020).

The question of whether opportunities are discovered or created has generated a strong debate in the literature (Ramoglou and Gartner, 2022). Previous contributions have recognised the different ontological natures of the discovery and creation perspectives and have predominately utilised one or the other in examining OR (Jones and Barnir, 2019). However, Álvarez et al. (2013) emphasise the necessity for integrating both perspectives. More recently, certain studies deny the competing ontological assumptions and consider the discussion about discovery and creation opportunities an artificial debate that has only served to generate confusion (Foss and Klein, 2020; Davidsson, 2021; Ramoglou and Gartner, 2022).

We agree with Alvarez and Barney (2020) that the distinction between discovery and creation perspectives has been fruitful in moving the field of entrepreneurship forward. Our aim is not to contribute to the debate regarding the ontological origin of opportunities, but we adopt an integrative framework and, following the contingency approach, consider that the discovery and creation perspectives are based on different contextual assumptions (risk vs. uncertainty). Accordingly, the effectiveness of OR in both contexts might be influenced by different factors (Hmieleski et al., 2015; Jones and Barnir, 2019).

A review of the literature on OR reveals that both the conceptual debate discussing the integration of the two perspectives and the empirical evidence on the factors that influence OR in each context have grown in recent years. However, inconsistent views on the factors affecting OR in a discovery versus creation context persist (Aldawod, 2022; Donbesuur et al., 2022).

Therefore, the main purpose of this paper is to analyse the influence of factors linked to the academic entrepreneur on ASOs' OR capacity, such as entrepreneurial self-efficacy, prior managerial and entrepreneurial experience, and industry and academic networks. We apply a contingency approach

to examine whether the relevance of these factors depends on the context in which OR occurs. Therefore, our research questions are: (i) What factors affect OR of ASOs in discovery and creation contexts? and (ii) Does the relevance of these factors differ in these contexts?

We contribute to the literature in various ways. First, we contribute to the debate regarding the question of whether opportunities are discovered or created. Although we do not aim to enter the debate on the ontological origin of opportunities, we provide empirical support for the integrative perspective, by analysing the factors that may influence OR in discovery and creation contexts. In this respect, recent studies have highlighted that there is still no agreement on the factors affecting OR in a discovery versus creation scenario and therefore more research is needed (Jones and Barnir, 2019; Mohammadi and Heshmati, 2021). Second, although previous literature on academic entrepreneurship emphasises the importance of understanding the factors that lead academics to discover or create opportunities, no previous theoretical debate nor empirical quantitative studies exist that analyse the influence of such factors on OR from a contingency approach (Hannibal et al., 2016). Most previous studies have considered that ASOs operate in a creation context. Our research is one of the first attempts to theoretically propose and empirically test not only that ASOs are heterogeneous and may both discover and create opportunities, but also whether the OR of ASOs requires matches between the factors linked to the academic entrepreneur and the context in which these firms operate. Finally, some of our findings differ from those of previous studies, which indicates that the factors affecting OR depend both on the context in which firms operate, and also on the type of companies analysed.

The paper is divided into the following sections. The second section describes the theoretical premises about discovery and creation perspectives and the contextualises the study in the academic entrepreneurship literature. The third section is devoted to hypotheses. In the fourth and fifth sections, methods and results are presented. Finally, we discuss the results obtained, and present the main conclusions, limitations, future research lines and practical implications of the study.

2. Theoretical background

2.1. *The discovery versus creation perspectives*

Opportunities can be defined as 'situations in which new goods, services, raw materials, markets, and

organising methods can be introduced through the formation of new means, ends, or means-ends relationships' (Eckhardt and Shane, 2003, p. 336). According to George et al. (2016), an opportunity provides a new or better supply–demand combination or a solution to reduce the supply and demand market imbalances.

OR forms the central core of entrepreneurial activity (Song et al., 2017), since it can lead to entrepreneurial actions (George et al., 2016). Hills and Singh (2004) define OR as the perception of a possibility for new profit potential through the founding of a new venture, or the improvement of an existing one, and involves several steps. Recent studies argue that OR is important both in the creation stage of a new venture and during the whole life of the firm (Mohammadi and Heshmati, 2021; Aldawod, 2022).

Traditionally, two perspectives have been employed to analyse OR: discovery and creation (Álvarez and Barney, 2007; Welter and Alvarez, 2015). The opportunity-discovery perspective is based on the premise that opportunities are objective and are formed by exogenous shocks to existing markets, which lead to opportunity discoveries because alert entrepreneurs recognise them (Álvarez and Barney, 2007; Álvarez et al., 2013). Therefore, opportunities are real and exist separately from the actions of the individuals (Kirzner, 1973). The discovery context may be defined as risky: Entrepreneurs do not know the result of exploiting the discovered opportunity (Zahra, 2008). However, by using past industry and entrepreneurial experience, and market knowledge, entrepreneurs might forecast possible results (Jones and Barnir, 2019; Smith et al., 2019). Following Sarasvathy et al. (2003), opportunity discovery might emanate from two situations: (i) the product is based on an existing technology, and they exploit the opportunities by covering emergent markets; or (ii) the product is based on a new technology, and they compete in an existing market.

On the contrary, the opportunity-creation perspective assumes that opportunities do not exist

until entrepreneurs create them (Álvarez and Barney, 2014; Neill et al., 2017). Thus, entrepreneurs identify opportunities subjectively (Álvarez et al., 2013). They start with their prior beliefs and initiate a transformative process by engaging in actions, social interactions and an iterative learning process that leads to the creation of opportunities (Mitchell et al., 2008; Stern et al., 2017). Drawing on the external feedback, the entrepreneur will adjust their ideas to act further (Álvarez et al., 2013). The creation context might be defined as uncertain since the entrepreneur has insufficient information to ascertain the possible results of their decisions and the likelihood of those results occurring (Sarasvathy et al., 2003; Zahra, 2008; Álvarez et al., 2013).

The main assumptions of the two perspectives are summarised in Table 1.

In this paper, we adopt an integrative framework and, following the contingency approach, consider that the discovery and creation perspectives are based on different contextual assumptions (risk vs. uncertainty) (Álvarez and Barney, 2007). If risky and uncertain contexts have different connotations regarding the novelty of the technologies that firms develop, the markets in which they compete, and the information available in the marketplace, then the effectiveness of OR in the two contexts might be influenced by different factors, or these factors might hold different relevance (Hmieleski et al., 2015; Jones and Barnir, 2019).

A review of the literature on OR reveals that inconsistent and rival views on the factors affecting OR in a discovery versus creation context are still present. First, the high number of factors that determine the OR process makes it challenging to develop a model that covers a reasonable number of such factors (Mohammadi and Heshmati, 2021). Second, existing empirical evidence in different types of firms is contradictory, since several studies find positive effects of certain factors, such as networks, managerial and industrial experience, on OR in a specific context (discovery vs. creation), while others obtain non-significant results (Neill et al., 2017; Chetty et

Table 1. Central assumptions of the discovery and creation perspectives

	Discovery perspective	Creation perspective
Nature of the opportunity	Opportunities are objective and are formed by exogenous shocks	Opportunities are formed endogenously by the entrepreneur
Nature of the process of OR	Entrepreneurial alertness Previous experience and knowledge Market information	Entrepreneur's vision and initial beliefs Iterative learning process Co-creation with industry agents
Nature of the context	Risky (The product is based on an existing technology <i>or</i> market demand exists)	Uncertainty (The product is based on an emergent technology <i>and</i> market demand is emergent)

Source: Own elaboration.

al., 2018; Jones and Barnir, 2019; Smith et al., 2019). These contradictory results may be because the influence of these factors not only differs in accordance with the discovery versus creation context, but also with the type of firm analysed (Donbesuur et al., 2022).

In the academic entrepreneurship context, the literature on the factors influencing OR is even scarcer and remains highly incipient, and the consideration of the contingency approach is almost non-existent (Hannibal et al., 2016). Therefore, in order to ascertain the factors affecting OR in ASOs, a more in-depth analysis is necessary.

2.2. Contextualising the academic spin-offs

ASOs are defined as new ventures that commercially exploit knowledge, technology and/or research results that have been developed within a university (Pirnay and Surlemont, 2003; Iacobucci and Micozzi, 2015). These firms are founded by academic researchers, who may or may not remain affiliated to the university (Clarysse and Moray, 2004).

Vohora et al. (2004) highlighted that OR is the first critical juncture that ASOs should overcome. However, academic entrepreneurs define the opportunity imprecisely and ambiguously in the initial stages of development due to conflicting objectives and insufficient market experience and networks, which hinders their OR (Mira-Solves et al., 2021; Khodaei et al., 2022; Tagliazucchi and Marchi, 2022).

Thus, the primary activities of ASOs' founders as academics are teaching and research. As entrepreneurs, they become a key contributor in the process of commercialising research outputs (Abd Rahim et al., 2015). Although higher education policies claim the complementarity between the traditional academic tasks and the third mission, empirical research has shown trade-offs between them (Reymert and Thune, 2023). While the role as academic is usually driven by publications and peer recognition, the role as an entrepreneur is driven by products and profits. The effort to integrate these two conflicting roles may affect academic entrepreneur's ability and performance on either activity, impeding the commercialisation process (Abd Rahim et al., 2015).

Due to their dual role, academic founders present some idiosyncratic characteristics that may either increase or hinder their OR ability. Thus, some authors claim that academics provide an advantage to innovative start-ups because their experience as researcher encourages intellectual curiosity and

the desire to explore different solutions and technological combinations, increasing their creativity and their capacity to continuously innovate, and develop technologically advanced products (D'Este et al., 2012; Abd Rahim et al., 2015; Hahn et al., 2019). However, many authors argue that they do not have market knowledge, business skills and social capital which are essential for technology transfer. Consequently, they tend to focus their business proposal on technical aspects instead of capturing market opportunity (Abd Rahim et al., 2015).

Consequently, once ASOs have been created, they must redefine their initial opportunities. Moreover, they are often founded around a technology platform, and need to identify new opportunities in later stages (Clarysse, Wright, et al., 2011b). Finally, as these firms often compete in dynamic and hypercompetitive markets, they must continually strive to identify new opportunities (Wright et al., 2007; Sousa-Ginel et al., 2021). Therefore, OR acquires a special relevance for ASOs throughout their life cycle.

Given this relevance, a number of recent studies have focused on analysing the factors that determine OR in ASOs, being the most critical factors: academic networks; industry networks; prior industry and entrepreneurial experience; and cognitive characteristics, such as self-efficacy (D'Este et al., 2012; Rasmussen et al., 2014; Hannibal et al., 2016; Abd Rahim et al., 2021; Mira-Solves et al., 2021). However, despite the increasing number of studies analysing OR in ASOs, the majority fail to consider the discovery versus creation context. According to Zahra (2008), both the technology and the market may define the context of ASOs. If the search for opportunities is developed close to the technology base and ASOs exploit these by covering an existing gap in nearby markets, then opportunities are discovered. If ASOs venture into unrelated technological territories, and explore radically different opportunities distant from their knowledge base, then they are developing the seed for creating opportunities.

Therefore, this study applies a contingency approach by considering both contexts to analyse the relevant factors for ASOs' OR, such as entrepreneurial self-efficacy, previous entrepreneurial and managerial experience, and industry and academic networks (D'Este et al., 2012; Hannibal et al., 2016; Mira-Solves et al., 2021). The baseline premise is that OR requires matches between the context in which ASOs operate (discovery or creation) and the aforementioned factors.

3. Hypothesis development

3.1. Entrepreneurial self-efficacy

Entrepreneurial self-efficacy can be defined as an individual's confidence in his/her ability to succeed in entrepreneurial roles (Hannibal et al., 2016), and it is considered as a key antecedent of OR, both in the discovery and in the creation context (Newman et al., 2019), although this relevance is greater in a creation context (Neill et al., 2017). This is mainly because entrepreneurs who recognise opportunities in a creation context must rely more on their skills, knowledge and intuition due to the lack of information in emergent markets (Hmieleski et al., 2015).

In the context of academic entrepreneurship, some arguments may lead us to conclude that entrepreneurial self-efficacy is especially determinant for OR in the creation context. From an effectual perspective, the creation of opportunities requires industrial knowledge and relationships, which academic entrepreneurs often lack as a result of their academic origins (Saravathy et al., 2014; Diáñez-González et al., 2021). Entrepreneurial self-efficacy may supply the answer to such deficiencies, by providing academic entrepreneurs with passion, self-belief, resilience and other cognitive skills, which are valuable for the creation of opportunities (Prodan and Drnovsek, 2010; Hmieleski et al., 2015; Hannibal et al., 2016).

Following these arguments, we propose our first hypothesis:

H1: Entrepreneurial self-efficacy is positively related to OR in ASOs and is of greater relevance in a creation context than in a discovery context.

3.2. Previous entrepreneurial experience

Previous entrepreneurial experience refers to the participation of the members of the management team in the start-up of other ventures before ASO's foundation (Cantner and Goethner, 2011). Although it is a key factor for OR both in the creation and discovery contexts (Gruber et al., 2012; Hmieleski et al., 2015), we expect a stronger effect for the creation of opportunity. First, ASOs may be highly likely to face the liability of newness (Fisher et al., 2016), because of the tacit and disruptive nature of their knowledge base (Clarysse, Tartari, et al., 2011a; Mathisen and Rasmussen, 2019). Under these circumstances, in which the information tends to be extremely reduced, entrepreneurial experience provides entrepreneurs with the specific knowledge of competitive conditions

for the creation of opportunities (Cantner and Goethner, 2011; Hmieleski et al., 2015). Moreover, Skute (2019) states that academic entrepreneurs may have relevant scientific expertise for the detection of technological opportunities, but are expected to lack the abilities and contacts necessary for the development of the process of trial and error in the experimentation necessary for the creation of opportunities (Álvarez et al., 2013). Therefore, prior entrepreneurial experience may be crucial for such deficiencies to be solved and opportunities to be created.

Following these arguments, we formulate our second hypothesis:

H2: Previous entrepreneurial experience is positively related to OR in ASOs and is of greater relevance in a creation context than in a discovery context.

3.3. Previous managerial experience

Previous managerial experience refers to the participation of the management team's members in the management of other ventures before founding the ASO (Cantner and Goethner, 2011). Previous managerial experience has largely been related to the OR in a discovery context (Jones and Barnir, 2019). Entrepreneurs with prior managerial experience are expected to have the ability to scan the environment in the search for relevant information and to make sense of new information (Hmieleski et al., 2015). This could be especially difficult for ASOs, since their traditional mimetic isomorphism usually results in highly unbalanced management teams, with a prominent orientation towards academic and scientific terms and a notorious lack of knowledge regarding the market (Ensley and Hmieleski, 2005; Fernández-Alles et al., 2022). Therefore, those management teams that include managers with prior managerial experience are expected to pursue existing opportunities more proactively, through constant scanning, searching and exploration across technologies and markets (Andersson and Evers, 2015). By contrast, managerial experience may hinder the OR in a creation context, since it might make managers search for opportunities by drawing on their past experiences instead of pursuing innovative ways of acting entrepreneurially (Álvarez et al., 2013; Hmieleski et al., 2015).

Therefore, we propose the following hypothesis:

H3: Previous managerial experience is positively related to OR in ASOs in a discovery context.

3.4. Industry and academic networks

The influence of networks in OR in discovery and creation contexts has hardly been analysed. Within the academic field, it would be necessary to distinguish between academic and industrial networks, since they could play different roles in OR. Academic networks and academic entrepreneurs are derived from the same context and present similar backgrounds. That is why these networks can be valuable in a discovery context, since they can have prior knowledge of the technological bases that companies are using and help connect these bases with the new opportunities that exist in the markets (Upson et al., 2017; Khodaei et al., 2022). However, these networks have limited market skills and find it difficult to supply customised support in the commercialisation of ASOs' radical technologies (Clarysse et al., 2005). Consequently, they could be less useful in creation contexts. Upson et al. (2017) state that relationships with actors with similar backgrounds are less useful for opportunity creation because it makes it difficult for entrepreneurs to think differently.

Given the market constraints of academic networks, ASOs should establish relationships with industry actors who provide market knowledge substantially different from that of academic entrepreneurs (Abd Rahim et al., 2021; Mira-Solves et al., 2021). In this way, academic entrepreneurs can connect their scientific knowledge bases with the commercial knowledge of industry networks for co-creating opportunities (Álvarez et al., 2013; Upson et al., 2017). Furthermore, since industry actors act as vehicles of critical knowledge about customers' needs, new uses of their scientific discoveries, and/or competitors' products (Vohora et al., 2004), they can also help ASOs' OR in the discovery context.

Based on these arguments, we establish the following hypotheses:

H4: Industry networks are positively related to OR in ASOs in a discovery context and in a creation context.

H5: Academic networks are positively related to OR in ASOs in a discovery context.

Figure 1 summarises the hypotheses.

4. Methods

4.1. Sample

The population of the study consisted of all the Spanish ASOs founded during 2003–2011. In this

period, the Spanish context represents a relevant framework for conducting our research due to the increasing relevance of ASOs as an effective mechanism for technology transfer. Specifically, from the approval of the Organic Law of Universities in 2001 and the Spanish Plan of R&D 2000–2003, the creation of Spanish ASOs has notably increased, even in those years characterised by the economic recession (see Figure 2). To obtain information on this population, the 67 Spanish Technology Transfer Offices (TTOs) were contacted, obtaining a database of 555 ASOs.

Regarding information collection, this study forms part of a larger research project devoted to the success factors of Spanish ASOs. To meet the main objectives of this and other studies belonging to the project, we designed two questionnaires with a broad set of questions. The first questionnaire was composed of 25 questions regarding the origin of the ASO, its technological base, the human and psychological capital of the management team, and networks. This questionnaire was addressed to the main researcher who both participated in the founding of the ASO and was also a member of the management team at the time of the survey. The second questionnaire, composed of 22 questions, was addressed to a non-academic member of the management team that was directly involved in the management of the firm. The two questionnaires were pre-tested through in-depth interviews with 14 academic entrepreneurs and managers of 7 ASOs.

A specialised firm sent the final version of both questionnaires to the ASOs *via* email. Valid responses from the two questionnaires were received from 167 ASOs (response rate: 30.4%). Table 2 shows a detailed description of the ASOs in our sample.

To study the possibility of non-response bias, the age and number of employees of responding and non-responding ASOs were compared. The *p*-values of the *t*-tests for independent samples were 0.857 and 0.787 for age and number of employees, respectively. These results indicate the absence of a non-response bias.

Lastly, while it is true that the use of single respondents could lead to common-method variance (CMV), the literature has consistently relied on single key informants and has argued for the relevant benefits of this approach and the quality of the non-biased information provided by founders and CEOs (Tehseen et al., 2017; Kull et al., 2018). The potential occurrence of CMV in our data was analysed through two post hoc tests (Podsakoff et al., 2003; Tehseen et al., 2017).

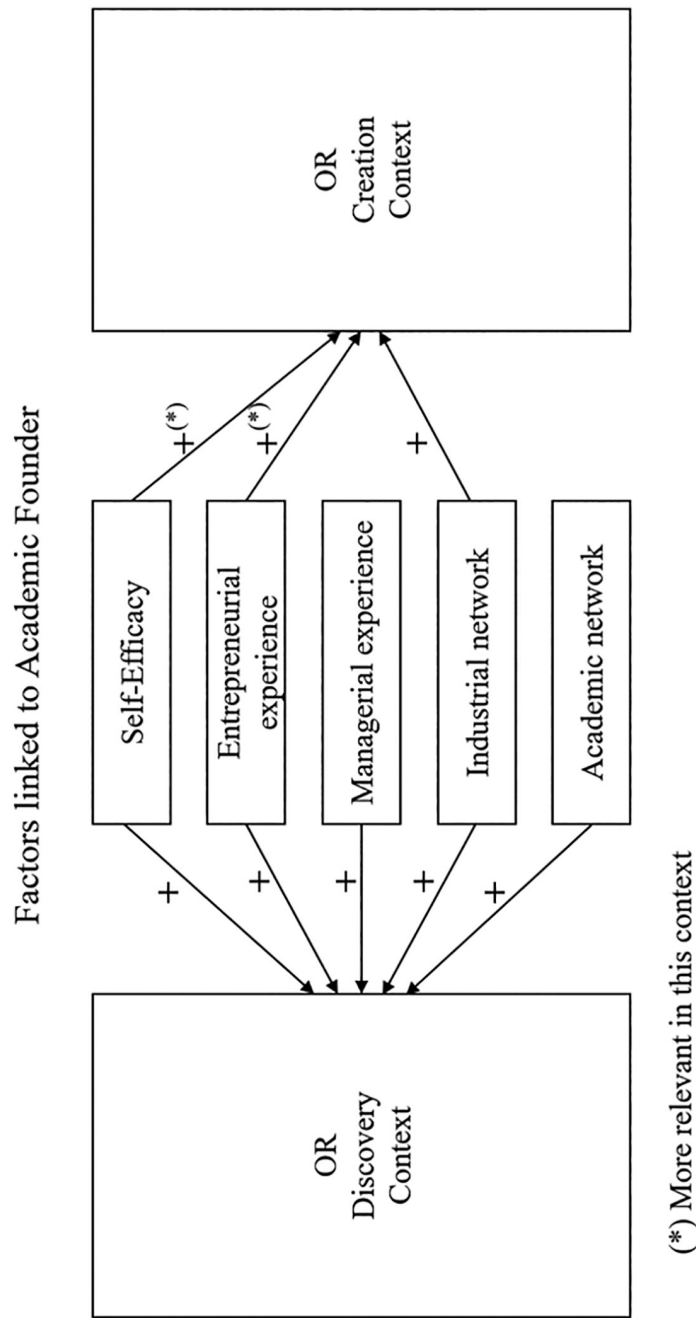


Figure 1. Theoretical model.

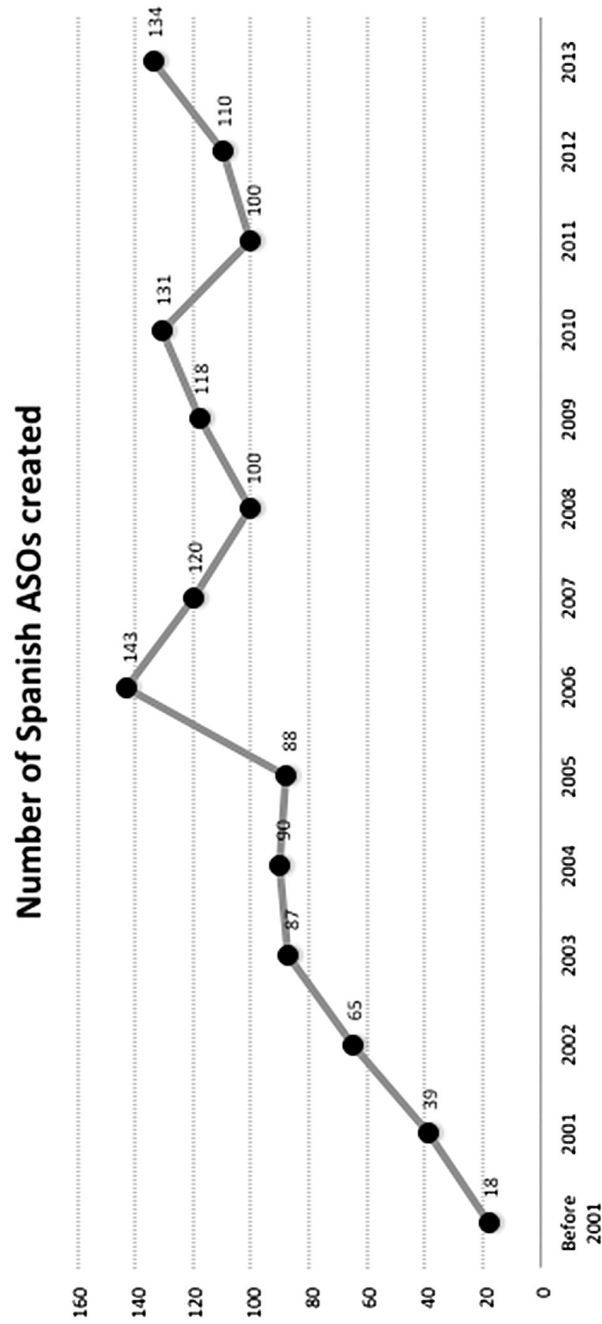


Figure 2. Evolution of the number of the Spanish ASOs created. *Source:* Authors' own, from Ortín et al. (2007), Castro et al. (2011), and RedOTRI y RedUGI (2015).

Table 2. Sample description

Age	<3 years 40.7%	Between 3 and 6 years 40.8%	Between 7 and 9 years 18.6%
Size	Mean 7.2	<10 employees 86.2%	Between 11 and 50 employees 13.8%
Industry	44 different NACE codes, being the more frequent industries Biotechnology, R&D, and Chemistry (45.5%)		
Incubator support	Yes 70.1%		No 29.9%
Scientific park	Yes 62.9%		No 37.1%
Target market size	Niche market 76%		Mainstream market 24%
Management team size	Mean 2.89	Minimum 1	Maximum 7
Stage of NPD	Idea 24.5%	Prototype 55.1%	Market-ready 20.4%
Stage of ASO development	Initial development 70.6%		Consolidation 29.4%

First, a Harman one-factor test was conducted (Podsakoff et al., 2003). The results revealed that several factors were obtained and that the first extracted factor explained 19.41% of the overall variance, which indicated that common-method bias is not a major concern in our study. To confirm these results, additional analyses were performed following an unmeasured single-common-method factor approach as recommended by Podsakoff et al. (2003). Specifically, a measurement model with the relevant latent constructs in our model (OR and entrepreneurial self-efficacy) was compared with a measurement model with the same constructs and an additional unmeasured single-common-method factor. Results indicated that the method factor did not improve model fit and that the difference in variance between the hypothesised model and the common-method factor model was only 1.18%, which lies well below the 25% threshold. This indicated that the effects of common-method bias remained limited (Williams et al., 1989).

4.2. Measures

4.2.1. Dependent and independent variables

The scales employed to measure the dependent variable (OR) and independent variables (entrepreneurial self-efficacy, previous entrepreneurial and managerial experience, and academic and industry networks) are shown in Appendix A. With respect to OR and entrepreneurial self-efficacy, since these variables were measured through a set of items, we performed two principal component analysis. In both cases, the

results of these analysis reported appropriate levels of internal consistency and correct sampling adequacy ($\alpha=0.844$ for OR; $\alpha=0.775$ for entrepreneurial self-efficacy). Thus, we used the mean value of the three items of the scale for measuring OR and the mean value of the five items of the scale for measuring entrepreneurial self-efficacy. With respect to the team-level variables, as we noted in Appendix A, we use two measures, one to assess the number of members of the team that had experience starting up a business, and the other one to measure their experience working as a manager for a firm (Bonardo et al., 2010; Cantner and Goethner, 2011). Regarding industry and academic networks, we used the logarithm of the number of contacts with industrial agents (customers, suppliers and business advisors) and the logarithm of the number of contacts with academic agents (academic support units and research colleagues) (Soetanto and Van Geenhuizen, 2015). All of these scales were based on the existing literature and were included in the questionnaire directed to the main academic entrepreneur.

4.2.2. Contingency variable: discovery and creation contexts

Following Sarasvathy et al. (2003) and Zahra (2008), the discovery versus creation context is defined by the degree of novelty of the ASO's technology and by the novelty of the market in which the company competes. This is because an opportunity implies a match between a technology possessed by the firm and a potential application to the market.

To measure the level of novelty of the technology, we asked the main academic entrepreneur to describe

the technology/knowledge around which the ASO had been founded, using a 5-point Likert scale (1=It is completely new technology/knowledge; 5=It is existing technology/knowledge) (Clarysse, Wright, et al., 2011b). Another member of the entrepreneurial team who was directly involved with the management of the ASO was asked to describe, on a 5-point Likert scale, the market in which the ASO competed (1=It is a mature market (customer needs are well defined and stable); 5=it is an emergent market (customer needs are not well defined and are changing)) (Autio and Lumme, 1998). Since the novelty of the technology was formulated in reverse terms, we transformed it in such a way that value 5 indicated the highest degree of novelty of both the market and the technology, and value 1 indicated the lowest degree of novelty. The combination of these two variables was employed to determine the discovery versus creation context.

4.2.3. Control variables

ASO-level control variables include the firm's age (number of years from the founding of the firm until the year 2012) and size (logarithm of the number of employees). Entrepreneurial team-level control variables included the percentage of women in the team, the proportion of non-academic managers in the team (Visintin and Pittino, 2014), and age diversity (degree to which the entrepreneurial team members represent a difference in age, using a 5-point Likert scale (1=very small degree; 5=very large degree) (Diáñez-González and Camelo-Ordaz, 2016). We also controlled for the number of ASOs created in each University until 2012 (Algieri et al., 2013).

5. Data analysis and results

To test the moderating effect of the discovery versus creation context, we divided the sample using the combination of the novelty of the technology, and the market in which the ASO operates.

In accordance with Autio and Lumme (1998) and Newbert (2005), values of the novelty of the market ranging from 1 to 3 are considered as referring to mature markets, while values 4 and 5 denote emergent market. Similarly, when the novelty of the technology takes values from 1 to 3, the ASO is considered as being based on existing technology, while values 4 and 5 refer to new technology. Furthermore, following Sarasvathy et al. (2003), when the technology is completely new and the market is emergent (both variables take values 4 or 5), then the ASO is considered as operating in a creation context. When only one of these values already exists but the other

is new (the technology or the market takes values 4 or 5, and the other variable, 1 to 3), then the firm operates in a discovery context. Finally, in those cases in which the technology exists and the market is established (both variables take values 1 or 2), then opportunities are rather obvious and are neither created nor discovered (e.g., franchises). In our sample, 35 ASOs were characterised as operating in a creation context, and 123 in a discovery context. The remaining nine ASOs were declared as being based on existing technology and as operating in a mature market. Since the purpose of this paper is to analyse the discovery versus creation context, these nine ASOs were eliminated.

Table 3 shows the descriptive statistics and the correlation matrix for the variables of the study. Values of the variance inflation factor (VIF) and the condition index remained within the established limits (VIF<3.3 and condition index <10) (Kumari, 2008; Kim, 2019).

In order to test the hypotheses established in our study, an ordinary least squares (OLS) multiple regression analysis was used in both samples (Table 4). Moreover, we employed a multigroup analysis to examine the differences between the coefficients of regression of the two samples (Table 5). Table 4 shows that the adjusted coefficient of determination (adjusted R^2) is adequate, significant and not dependent on the number of variables introduced in the model both in the discovery context (adjusted $R^2=0.192$, $p<0.001$) and in the creation context (adjusted $R^2=0.392$, $p<0.05$). The results indicate that entrepreneurial self-efficacy is positively related to OR in the discovery context ($\beta=0.29$; $p<0.001$) and in the creation context ($\beta=0.51$; $p<0.05$). Furthermore, although the coefficient of entrepreneurial self-efficacy is higher in the creation context, the t -test of the multigroup analysis reveals that there are no significant differences between the two subsamples (t -test= 1.020), and therefore, it can be concluded that self-efficacy is equally relevant in the two contexts (Table 5). Therefore, Hypothesis 1 is partially supported. Second, we find no significant relationship between previous entrepreneurial experience and OR in either context. Thus, Hypothesis 2 is not supported. Third, we find that previous managerial experience is positively related to OR in the discovery context ($\beta=0.43$; $p<0.001$). Furthermore, this variable is negatively related to OR in the creation context ($\beta=-0.46$; $p<0.05$). The t -test of the multigroup analysis also revealed that there is a significant difference between the two subsamples (t -test=-3.465, $p<0.001$) (Table 5). Therefore, Hypothesis 3 is supported. Fourth, we find a positive and significant relationship between industry networks and OR in the discovery context ($\beta=0.22$; $p<0.05$),

Table 3. Means, standard deviations and correlations

Variables ^a	Min	Max	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	
1 OR	1.00	5.00	3.60	1.01												
2 Self-efficacy	1.00	5.00	3.86	0.65	0.35***											
3 Entrepreneurial experience	0.00	5.00	0.68	0.96	0.12	0.05										
4 Managerial experience	0.00	5.00	0.59	0.84	0.14	-0.04	0.44***									
5 Industrial network	0.00	8.70	2.73	1.23	0.09	-0.03	0.00	-0.06								
6 Academic network	0.00	5.99	1.54	1.07	0.20*	0.02	0.12	0.17*	0.15							
7 University number of ASOs	2.00	34.00	17.52	9.67	-0.03	0.07	-0.02	-0.01	0.12	0.02						
8 Age of ASOs	1.00	9.00	4.44	2.19	-0.06	-0.03	-0.11	0.09	0.35***	0.10	-0.09					
9 Size of ASOs	0.00	3.85	1.67	0.77	0.03	0.16*	0.08	0.25***	0.33***	0.15	0.06	0.38***				
10 Percentage of women	0.00	1.00	0.23	0.33	0.06	0.10	-0.15*	-0.05	-0.04	-0.09	0.05	0.06	-0.11			
11 Proportion of non-academic	0.00	2.00	0.57	0.56	-0.07	0.07	0.09	0.15	0.02	0.05	0.02	-0.04	0.05	-0.12		
12 Age diversity	1.00	5.00	2.19	1.25	0.07	0.18*	.22***	0.17*	0.00	-0.13	-0.09	-0.07	0.25***	0.02	0.11	

^aN = 167.

*Significant at $p \leq 0.05$;

**Significant at $p \leq 0.01$.

while in the creation context, this relationship is only marginally significant ($\beta=0.36$; $p<0.1$). Furthermore, the t -test of the multigroup analysis reveals there to be no significant difference between the two subsamples (t -test=0.864) (Table 5). Therefore, Hypothesis 4 is supported. Lastly, we find that the academic network is positively related to OR in the discovery context ($\beta=0.20$; $p<0.05$), while this relationship is non-significant in the creation context. Moreover, the t -test of the multigroup analysis reveals there to be a significant difference between the two subsamples (t -test=-2.201, $p<0.01$) (Table 5). Therefore, Hypothesis 5 is supported.

With respect to the control variables, only the number of ASOs created in the University is found to be marginally and negatively related to OR in the creation context ($\beta=-0.27$; $p<0.10$).

In order to determine the relative importance of each of the different factors related to OR of ASOs, we considered the partial and semi-partial coefficients of correlation of the dependent variable with respect to each factor (Johnson and LeBreton, 2004). Regarding the discovery context, Table 6 shows that the partial and semi-partial coefficients of correlation of prior entrepreneurial experience are not significant (the 0 falls within the confidence intervals). The results for entrepreneurial self-efficacy, prior managerial experience, and industry and academic networks are significant. Moreover, the partial and semi-partial coefficients of prior managerial experience are higher (0.36 and 0.33, respectively) than those of entrepreneurial self-efficacy, and those of industry and academic networks. Hence, the results indicate that prior managerial experience is the most relevant factor for OR in the discovery context. With respect to the creation context, Table 6 also shows, on the one hand, that the partial and semi-partial coefficients of correlation of prior entrepreneurial experience and academic networks are not significant (the 0 falls within the confidence intervals). On the other hand, the results show that entrepreneurial self-efficacy, prior managerial experience, and industry networks are all significant. Furthermore, the partial and semi-partial coefficients of entrepreneurial self-efficacy are higher (0.48 and 0.35, respectively) than those of industry network and prior managerial experience. Therefore, the results indicate that entrepreneurial self-efficacy is the most relevant factor for OR in the creation context.

6. Discussion

The aim of the study was to analyse the relevance of different antecedents of OR in ASOs, while

Table 4. Results of the linear regression analysis

Variables	Discovery context					Creation context						
	Non-standardised coefficients					Standardised coefficients						
	β	SE	t	α	β	SE	t	α	β	SE	t	α
Constant	-0.34	0.35	-0.98	0.330	0.25	0.78	0.31	0.756	-0.27	0.02	-1.77	0.091 [†]
University number of ASOs	0.01	0.01	0.60	0.549	-0.03	0.02	0.41	0.685	0.06	0.08	0.41	0.685
Age of ASOs	-0.04	0.05	-0.80	0.424	0.04	0.08	-1.07	0.296	-0.24	0.28	-1.07	0.296
Size of ASOs	-0.24	0.15	-1.66	0.100	-0.30	0.51	-0.03	0.975	-0.01	0.51	-0.03	0.975
Percentage of women	0.17	0.26	0.63	0.528	-0.02	0.35	-1.13	0.272	-0.18	0.35	-1.13	0.272
Proportion of non-academic	-0.22	0.15	-1.51	0.135	-0.39	0.20	0.57	0.577	0.12	0.20	0.57	0.577
Age diversity	0.01	0.07	0.13	0.894	0.11	0.27	2.52	0.020*	0.51	0.27	2.52	0.020*
Self-efficacy	0.31	0.09	3.27	0.001**	0.69	0.14	1.12	0.278	0.20	0.14	1.12	0.278
Entrepreneurial experience	-0.10	0.11	-0.87	0.388	0.16	0.24	-2.62	0.016*	-0.46	0.24	-2.62	0.016*
Managerial experience	0.46	0.12	3.92	0.000**	-0.62	0.19	2.04	0.054 [†]	0.36	0.19	2.04	0.054 [†]
Industrial network	0.16	0.07	2.20	0.030*	0.40	0.17	-1.10	0.283	0.36	0.17	-1.10	0.283
Academic network	0.17	0.08	2.12	0.037*	-0.18	0.601			-0.19	0.601		
R^2	0.272				0.601							
Adjusted R^2	0.192				0.392							
F	3.401**				2.873*							

[†]Significant at $p \leq 0.10$;

*Significant at $p \leq 0.05$;

**Significant at $p \leq 0.001$.

Table 5. Multigroup analysis results

	β creation context	β discovery context	β creation context – β discovery context	<i>t</i> -test
Self-efficacy → OR	0.513	0.289	0.224	1.020
Entrepreneurial experience → OR	0.196	–0.089	0.285	1.304
Managerial experience → OR	–0.464	0.427	–0.891	–3.465*
Industrial network → OR	0.360	0.218	0.142	0.864
Academic network → OR	–0.187	0.196	–0.383	–2.201**

* Significant at $p \leq 0.001$;** Significant at $p \leq 0.01$.

considering the discovery and creation contexts. Our results indicate that in a discovery context, entrepreneurial self-efficacy, previous managerial experience and industrial and academic networks are relevant for OR; while in a creation context, entrepreneurial self-efficacy and industrial networks favour OR.

We find that entrepreneurial self-efficacy is relevant for both contexts, and constitutes the most critical factor in the creation context. In a discovery context, entrepreneurial self-efficacy may foster the academic entrepreneurs' efforts to discover opportunities, because the most self-efficacious entrepreneurs may hold a stronger belief in the success of their screening efforts (Mira-Solves et al., 2021). In a creation context, the exhibition of high levels of entrepreneurial self-efficacy constitutes a requirement for entrepreneurs to act on imagined possibilities and to be able to tackle contexts in which the information on the markets remains unavailable (Neill et al., 2017). The role of entrepreneurial self-efficacy in both contexts may be due to the idiosyncratic characteristics of ASOs. Academic entrepreneurs often possess high levels of scientific knowledge, but insufficient commercial skills, and consequently might need to be confident in their entrepreneurial capabilities in order to feel able to recognise opportunities in any type of context. Furthermore, in a creation context, these market deficiencies and the high level of uncertainty, lead to academic entrepreneurs needing high levels of confidence in their entrepreneurial abilities to co-create opportunities (Angel Ferrero and Bessi ere, 2016).

Previous managerial experience is the most significant factor in a discovery context. These findings indicate that academic entrepreneurs with previous managerial experience are likely to possess specific knowledge regarding the competitive nature of the markets where ASOs operate and, consequently, will be better equipped to discover opportunities. However, we found that in a creation context, previous managerial experience negatively relates to OR (Neill et al., 2017; Jones and Barnir, 2019). In a creation context, the use of mental schemes associated

with previous managerial experience could hinder the creative process necessary for OR. Villani et al. (2017) state that academic entrepreneurs without managerial experience who are guided by academic logic are more inclined to possess the speculation and imagination necessary to create opportunities. This constitutes a relevant finding of our study since the lack of previous managerial experience has been considered in the literature as one of the most important deficiencies of academic entrepreneurs to recognise and exploit opportunities. Our study demonstrates that the relevance of this factor depends on the context in which the ASO operates.

With respect to networks, our results corroborate that academic networks are relevant in the discovery context. Since ASOs are created in the university context, their research colleagues might know their technology bases and help them discover opportunities (Ensley and Hmieleski, 2005). TTOs could help ASOs in the discovery of existing opportunities by supplying them with training and transfer of experiences (Wright et al., 2007; Khodaei et al., 2022). Since these networks are close connections to the ASOs, they could also be expected to play a relevant role in the creation context, given the constructionist nature of the process (Smith et al., 2019). However, our results confirm that these networks are not relevant in a creation context. Explanations for these results could include the possibility that academic networks may lack the necessary market knowledge and skills to help ASOs in an uncertain context, and/or that the overlap of the knowledge bases of ASOs and academic networks fails to contribute to the creation of opportunities. For its part, the role of industrial networks for ASOs is relevant in both contexts. Industrial networks might grant academic entrepreneurs access to new and complementary knowledge, providing them with the possibility of redefining the initial opportunities for the identification of new applications of their technological platforms (Hannibal et al., 2016; Upson et al., 2017). In a discovery context, these networks serve as channels of information regarding changes

Table 6. Zero-order, partial and semi-partial correlation coefficients of the linear regression model

Variables	Discovery context					Creation context				
	95% confidence interval			Correlations		95% confidence interval			Correlations	
	Lower limit	Upper limit	Zero-order	Partial	Semi-partial	Lower limit	Upper limit	Zero-order	Partial	Semi-partial
University number of ASOs	-0.01	0.02	0.10	0.06	0.05	-0.06	0.01	-0.34	-0.36	-0.24
Age of ASOs	-0.13	0.05	-0.03	-0.08	-0.07	-0.14	0.21	-0.13	0.01	0.06
Size of ASOs	-0.53	0.05	0.01	-0.17	-0.14	-0.87	0.28	0.00	-0.23	-0.15
Percentage of women	-0.36	0.70	0.09	0.06	0.05	-1.07	1.04	-0.04	-0.01	-0.00
Proportion of non-academic	-0.52	0.07	-0.03	-0.15	-0.13	-1.11	0.32	-0.33	-0.24	-0.16
Age diversity	-0.13	0.15	0.03	0.01	0.01	-0.30	0.52	0.03	0.12	0.08
Self-efficacy	0.12	0.49	0.25	0.31	0.28	0.12	1.25	0.44	0.48	0.35
Entrepreneurial experience	-0.32	0.13	0.12	-0.10	-0.07	-0.14	0.46	0.21	0.24	0.15
Managerial experience	0.23	0.69	0.32	0.36	0.33	-1.11	-0.13	-0.29	-0.47	-0.34
Industrial network	0.02	0.30	0.07	0.22	0.19	0.00	0.80	0.22	0.41	0.28
Academic network	0.01	0.33	0.21	0.21	0.18	-0.53	0.16	0.11	-0.23	-0.15

in technology, in market demand, and/or in government policy that may lead to discover opportunities (Abd Rahim et al., 2021). These results appear to contrast with the arguments of Smith et al. (2019) who suggest that certain types of entrepreneurs might discover and even create opportunities without needing social links. However, due to the idiosyncratic characteristics of ASOs, networks are critical, although the relevance of each type of network varies with the context.

Lastly, we found a non-significant effect of entrepreneurial experience in both contexts. Our evidence differs from the results obtained from prior research in other types of ventures (Gruber et al., 2012; Neill et al., 2017; Jones and Barnir, 2019). Considering this prior empirical evidence, this non-significant effect might constitute a particular characteristic of academic entrepreneurship. Previous entrepreneurial experience provides academic entrepreneurs with generic knowledge regarding the entrepreneurial process but does not necessarily supply valuable and specific knowledge for the recognition of a new opportunity. Another explanation could be derived from Hmieleski et al. (2015), who note that prior experience in founding a business provides knowledge that may be particularly useful when expanding a firm within a stable context. However, ASOs often face dynamic and complex contexts that require specific skills and knowledge. Consequently, previous experience in starting a business may not be useful for OR in the context of academic entrepreneurship.

7. Conclusions

Several conclusions can be derived from this study. First, factors linked to the academic entrepreneur are critical for OR in both the discovery and creation contexts, as stated in the entrepreneurship literature, despite the fact that it had not previously been properly tested empirically from a contingency approach. Second, in line with the demands of recent research, we have demonstrated the need to use a contingency approach, since the factors analysed differ in relevance depending on the context (Hmieleski et al., 2015; Neill et al., 2017). Third, although the study supports the application of premises of discovery and creation perspectives, the idiosyncratic characteristics of ASOs lead to certain results that are different from those obtained in the previous literature. Fourth, our study advances the literature on academic entrepreneurship since we have demonstrated that ASOs are heterogeneous and that these firms compete both in a creation and a discovery context. Finally, there is

a deficiency in the literature regarding how context is measured. Following Sarasvathy et al. (2003) and Zahra (2008), we have created a proxy of discovery and creation contexts, by considering the technology and the market of ASOs.

7.1. Limitations and future research areas

Our study also presents certain limitations that may suggest possibilities for further research. First, the use of cross-sectional data precludes drawing inferences regarding the causal direction of the relationships analysed. The causal relationships established are the result of accepting the premises inherent in the literature. However, future research should focus on longitudinal study since, with our cross-sectional data, we remain unable to verify the possibility that the relationships of causality might also operate in the opposite direction. Second, the subsample of firms operating in a creation context is composed of only 35 ASOs. However, a response rate of 30% of the population was obtained, and the empirical analyses demonstrated the non-existence of non-response bias. It is hence possible to infer that the sample is representative of the population, and the small size of the subsample of ASOs in a creation context reflects the characteristics of the population. Therefore, although it would have been desirable for the subsample composed of ASOs operating in a creation context to have been larger, this issue does not invalidate our research. Third, by taking the idiosyncratic characteristics of ASOs into account, as well as previous research (Jones and Barnir, 2019), we have employed perceptual data to measure the factors that affect OR as well as the novelty of the technology and the market. However, we recognise the convenience of using secondary and objective data to complement subjective measures. For example, the measure of academic and industrial networks, may be complemented with the number of projects, publications and patents the academic entrepreneur is involved in with colleagues and industrial agents (Barbieri et al., 2018). Fourth, this study has focused on those factors that have been more frequently analysed in the literature as antecedents of OR in discovery and creation contexts. However, we are aware that the consideration of other characteristics of the academic entrepreneur, such as creativity (Miranda et al., 2017a, 2017b) or engagement with knowledge transfer activities (Barbieri et al., 2018) will enrich future research. Finally, our data are composed of ASOs from the Spanish context. Future research could develop comparative studies of the Spanish context with other countries to analyse whether the institutional characteristics of different countries could affect the OR of ASOs.

7.2. Practical implications

Academic entrepreneurs must be aware of the importance of including non-academic managers and expanding their industrial networks to improve their entrepreneurial skills, to access information for the discovery of opportunities and to develop joint actions for the co-creation of opportunities. Regarding universities, due to their role circumscribed only in the discovery context, they should increase the professionalisation of their entrepreneurship support units to help ASOs in OR in the creation context. Universities could play a critical role, by developing specific meeting programmes with the company CEOs and industry agents that favour the co-creation process between the university and industry. Both universities and policy-makers should establish policies aimed at increasing the self-efficacy of academic entrepreneurs, since greater confidence in their entrepreneurial abilities is crucial for OR in both contexts. Finally, policymakers should promote an entrepreneurial ecosystem that facilitates not only the creation of ASOs, but also their development subsequent to their creation, when OR is still crucial.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Appendix A. Measures

Opportunity recognition (Clarysse, Tartari, et al., 2011a) $\alpha=0.844$

Please rate your agreement with the following statements (1 = strongly disagree; 5 = strongly agree):

- I frequently identify new opportunities to start up new business
- I frequently identify ideas that can be converted in new products or services
- I am generally interested in ideas that may materialise into profitable enterprises

Entrepreneurial self-efficacy (Wilson et al., 2007) $\alpha=0.775$

Please compare yourself to other entrepreneurs you know in the following skill areas (1 = much worse; 5 = much better):

- Being able to solve problems
- Being able to manage finances (*)
- Being creative
- Being able to reach consensus and agreement with other firms and entrepreneurs
- Making decisions

Previous entrepreneurial and managerial experience (Bonardo et al., 2010; Cantner and Goethner, 2011; Goethner et al., 2012)

Please indicate the number of members of the current entrepreneurial team that, previous to their incorporation into this ASO, had:

- Experience starting up a business
- Experience working as a manager for a firm

Industry and academic networks (Soetanto and Van Geenhuizen, 2015)

Please indicate the number of contacts that the ASO maintains with each of these actors:

- Customers and suppliers
- Business advisors
- Academic support units (TTOs and university incubators)
- Research colleagues

Novelty of the technology (Clarysse, Wright, et al., 2011b)

Please describe the technology/knowledge around which the ASO was founded (1 = It is completely new technology/knowledge; 5 = It is existing technology/knowledge)(+)

Novelty of the market (Autio and Lumme, 1998)

Please describe the market in which the ASO competes (1 = It is a mature market: customer needs are well defined and stable; 5 = it is an emergent market: customer needs are not well defined and are changing)

Items marked with (*) were dropped from the final scale; Items marked with (+) were formulated in reverse terms.