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The creation of academic spin-offs: University-Business Collaboration matters

Todd Davey[1] · **Sofía Louise Martínez-Martínez**[2] · **Rafael Ventura**[2] · **Victoria Galán-Muros**[3]

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Abstract
In discussions about Entrepreneurial Universities, it is essential to recognize that academics are at its heart and almost certainly the most important protagonists, particularly those who engage in academic spin-off creation (ASOs). However, understanding their entrepreneurial behavior is still limited, as is the connection to other important activities, such as University-Business Collaboration (UBC). Literature suggests that ASOs creation is conditioned by a great number of factors, but prior studies are limited in their approach and do not include the effect of the participation in other collaborative activities with the industry. This gap is addressed by unlocking spin-off creation from a multidisciplinary approach, integrating both psychological and sociological antecedents, as well as considering the influence of UBC in a much-needed international context. With data from a sample of 2,188 academics from 33 European countries, eleven hypotheses are tested using a structural equation model – The UBC-ASOs Model. Results show the relevance of the three UBC dimensions considered (attitude towards UBC, cultural support for UBC and UBC self-efficacy) for ASOS creation, as well as the effect of the cultural aspect in the psychological domain. Motivations are defined as drivers of UBC, while academics' social capital enhances their cultural support for UBC but does not influence their attitude towards UBC or their UBC self-efficacy. The central role of UBC reveals the importance of re-thinking academic entrepreneurship research from the broader perspective of collaboration, while having valuable policy and managerial implications and providing key insights on how to develop Entrepreneurial Universities.

Keywords Entrepreneurial University · Entrepreneurship · Academic spin-off · University-Business Collaboration · Motivations · Social capital

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Extended author information available on the last page of the article

1 Introduction

Whilst the higher education sector is experiencing a period of change (Ewing, 2020), the University's contribution to society through the three missions of education, research and engagement or economic development has consistently increased (Etzkowitz et al., 2000; Etzkowitz, 2003b; Galán-Muros & Davey, 2017; Hughes & Kitson, 2012), including through entrepreneurship (or enterprise) (Etzkowitz, 2003a; Rothaermel et al., 2007). Whether as a driver of a knowledge society (Löfsten & Lindelöf, 2002; Miller et al., 2016; Zaharia & Gibert., 2005), for its increasing importance in industry innovation (Perkmann et al., 2013), as part of the human resources supply chain for industry (Ginzburg & Houli, 2013) or as key driver in regional innovation systems or ecosystems (Etzkowitz et al., 2004; Feldman & Lowe, 2008; Prokop, 2021), the University's importance to society is recognized. This contribution has been embodied in the emerging literature on Entrepreneurial University (Arroyabe et al., 2022).

But the size and scope of the Entrepreneurial University's contribution is limited to the extent to which academics, as primary protagonists, engage with key stakeholders. Increasingly, Universities develop more strategies in order to align their internal resources to engage with society and collaborate with industry (Abramo et al., 2012; Klofsten et al., 2019; Tartari & Breschi, 2012; Tereshchenko et al., 2024), enabling a two-way-flow of influence between the university and a knowledge-based society (Etzkowitz et al., 2000), facilitating an interactive innovation model (Etzkowitz, 2003b). Particularly, the Bayh Dole Act in 1980 in the US (Rothaermel et al., 2007) facilitated the commercialization of science (Kenney & Patton, 2009) "fostering role identity modifications of university scientists" (Jain et al., 2009, p. 932). This permission given to academics to utilize their research results allowed the 'Cambridge Phenomenon' in Europe (Bruce, 1985). Thus, Universities, and their academics, are increasingly looked upon to provide specific outputs through entrepreneurial activity (Ivanova & Leydesdorff, 2014; Miller et al., 2018; Wang et al., 2021).

Given that the development of an Entrepreneurial University depends on the entrepreneurial behavior of the people who are part of the institution, making it more open, flexible and closer to industry and society, greater attention has been given to the individual role of the academic (Huyghe et al., 2016; Jain et al., 2009; Wang et al., 2021; Wright & Phan, 2018). Recent research such as the study developed by Engzell et al. (2024), highlight the critical role of academics through the commercialization of services, the creation of new organizations, the development of new technologies, or the establishment of new collaborations. In the same line, and based on previous research, it is possible to state that academics are a source of new inventions and technologies (Guerrero et al., 2016) and a source of new business start-ups (Zellmer-Bruhn et al., 2021), which leads to the emergence of new industries (Bercovitz & Feldmann, 2006) providing great value to the entrepreneurial ecosystem (Abootorabi et al., 2021; Prokop, 2021). Whilst several terms have emerged to capture how academics contribute, Academic Spin-Offs (ASOs) has received a great focus in the research developed during the last decades.

Until now, extant literature on ASOs and academic entrepreneurial behavior has focused on the individual characteristics of academics that are entrepreneurial (Hayter et al., 2018), their identity (Hayter et al., 2021) or intentions (Wright et al., 2006), barriers affecting engagement (Galán-Muros & Plewa, 2015), collaboration strategies (Miller et al., 2018), mechanisms that can be instituted to support its creation (Löfsten

& Klofsten, 2024), the impact of the entrepreneurial ecosystem (Prokop, 2021), or the economic outcomes of this kind of companies (Vincett, 2010).

Despite this coverage, there remains substantial gaps in the understanding of ASOs. First, few current studies have focused on the antecedents from a multidisciplinary approach, considering variables of different nature and the relationship between them. Most commonly, the literature on ASO antecedents has tended to identify individual characteristics (e.g., factors related to personality, attitudes, motivations, and experience) or contextual factors (e.g., social and cultural contexts, institutional and ecosystem characteristics and support) (Hossinger et al., 2020). However, there is a need for research that combines both kind of antecedents and deepen their relations. Second, studies on ASOs often lack an international perspective, with most studies being regional or national level studies (Martínez-Martínez et al., 2021). This means that the results are primarily bound by their context and cover a limited scope (Miranda et al., 2017). Third, the role of how University-Business Collaboration (UBC) affect ASOs has not been sufficiently addressed, despite ASOs being considered primarily a knowledge transfer activity (Prokop, 2023) and regularly a UBC activity (Perkmann et al., 2013) as it involves both public and private sector spheres (Prokop, 2023). Considering that the act of creating a spin-off by academics is not a common activity (Davey & Galán-Muros, 2020), its relationship with UBC, which would encompass a broader set of academics, and a much larger part of a University being entrepreneurial, should be explored.

To address these gaps, the study of ASO creation needs to be reframed, considering different types of antecedents, an international perspective and the role of UBC, and subsequently re-conceptualized within a broader context because of its significant consequences. This leads to the primary question underlying this research: "What is the influence of UBC, and other antecedents of psychological and sociological nature, on the creation of ASOs?".

Answering this research question, the paper aims to provide a more complete understanding of what influences academics to behave entrepreneurially in an international European context, re-defining the role of UBC in facilitating ASO creation, and in doing so, making a significant contribution to the Entrepreneurial University literature stream. To achieve this, an international dataset of 2,188 responses from academics in 33 countries is analyzed, applying a structural equation model (SEM), which allows a fuller explanation of ASOs. This includes the influence of UBC and integrates both psychological and sociological variables. In this way, we move to an approach based on the origin of academic entrepreneurial activity, focusing on the person who generates entrepreneurship through its behavior. This is a fundamental part of the re-thinking process to deepen the understanding of the formation and advancement of Entrepreneurial Universities.

The paper is structured as follows: the first section offers a theoretical background and builds the justification for a set of hypotheses. This is followed by a methodology section that flows into the presentation of results and a discussion with managerial implications. The final section presents the conclusions, limitations and suggestions for future research.

2 Hypothesis development and hypothesised model

2.1 Entrepreneurship at universities

The Entrepreneurial (Etzkowitz, 1983), Engaged (OECD, 1997) or Civic University (attributed to Bender, 1988) concepts have been increasingly embraced by policy makers and

Universities, to manage the change of the higher education institution (Wissema, 2009). Specifically, the Entrepreneurial University prescribes that Universities should contribute to the entrepreneurial capital of an economy by fostering entrepreneurial dynamics in their ecosystem (Audretsch, 2014). In words of Clark (2004), the Entrepreneurial University is conceived as a place possessing a capacity for change. So, it is a source of new knowledge and qualified entrepreneurial human capital committed to the advancement of society and is responsible for promoting the transfer of the outcomes generated within the institution to its environment (Guerrero et al., 2016; Zahra & Wright, 2011). In words of Etzkowitz (2003a, 2003b) "translating knowledge produced within the university into economic and social utility" (p.112). In this sense, the entrepreneurial outcomes of the University are determined by the entrepreneurial performance of the individuals that develop knowledge within the institution, i.e., the academics (Huyghe et al., 2016; Wang et al., 2021). With their activity they condition the level of entrepreneurship of the University, e.g., with the development of patents (Nelson, 2001), licensing income (Thursby et al., 2001) or ASOs activity (Shane, 2004). Thus, the individual and its behavior is at the heart of the Entrepreneurial University.

Despite the long-standing debates about how to transform and balance universities towards an entrepreneurial approach managing overloads and capability limitations (Clark, 1998b, 2001), the dynamics behind entrepreneurial oriented universities (Etzkowitz et al., 2019) and their successful models (Audretsch & Belitski, 2022), the effectiveness of policies and strategies (Mowery & Nelson, 2004) and their consistency with policies that support basic science research (Klofsten et al. 2019; Kleinman, 2003), or the ethics behind whether an academic should behave entrepreneurially (Jain et al., 2009; Laukkanen, 2003); the entrepreneurial behavior of academics has increased over the last 30 years with the advancement of the Entrepreneurial University paradigm (Clark, 1998a, 2004; D'Este & Perkman, 2011; Etzkowitz et al., 2004; Etzkowitz, 2003a, 2019; Perkmann et al., 2021). This evolution has also led to the emergence of new approaches that explain this phenomenon, such as university intrapreneurship. The concept of Intrapreneurial University aligns with the view that entrepreneurial activity can and should be stimulated within the boundaries of organizations (Guerrero et al., 2015) and has emerged to reflect the university's adoption of an entrepreneurial logic, adding this logic to the institutional logics that dominate the university governance, structure and processes (Engzell et al., 2024).

Even if the intrapreneurial orientation of universities is heterogeneous and depends on both internal factors, such as leadership, governance strategy or resources, and formal and informal external conditions (Klofsten et al., 2024), several studies highlight the critical role played by the academics (De Keyser & Vandenbempt, 2023; Flores et al., 2024; Henry & Lahikainen, 2024). When adopting an intrapreneurial perspective, the "impetus for entrepreneurial activities must originate from individual as opposed to the institution" (Phillipott et al., 2011, p. 168). So, academics identify opportunities and develop initiatives to generate value both for the university (e.g., securing funds, establishing new research centers, implementing pedagogical innovations) and its environment (e.g., addressing societal challenges through venture creation) (Klofsten et al., 2024). Being the source of entrepreneurial behaviour, the academic is a critical factor for the achievement of sustained competitiveness and growth (Flores et al., 2024).

2.2 ASOs as academic entrepreneurial behavior

Both academic entrepreneurship and intrapreneurship have been associated with the creation of new organizations in the academic context (Baruah & Ward, 2015). Assigning the

ownership of research to universities and academics has been an important step to advance this practice (Kenney & Patton, 2012). Particularly in relation to the creation of ASOs (Miller et al., 2016), these founders have been called 'academic entrepreneurs' (Davey & Galán-Muros, 2020; Miller et al., 2018).

This paper considers François and Philippart's (2019) definition of ASO, a firm created by professors, researchers, post-doctoral and other junior researchers from a University, grounded on a technology and/or knowledge generated within that University. This study, however, will not follow Bercovitz and Feldmann (2006) who suggests that ASOs can be created by professional staff. ASOs exist in a number of heterogeneous forms (Hossinger et al., 2020) and there is a great diversity among these firms in relation to their business model, growth model, international orientation or financing (Martínez-Martínez et al., 2021; Mustar et al., 2006).

There are several reasons for the interest in the study of ASOs. First, the potential offered by these companies include the localized impact that such organizations have, their ability to transform local economies (Bercovitz & Feldmann, 2006; Vincett, 2010) acting as an effective mode of knowledge and technology transfer (Davenport et al., 2002). ASOs are "intermediary vehicles in university knowledge transfer" (Prokop, 2023, p.239), a vehicle to commercialize products and services to the market that might otherwise have remained underdeveloped within the University, which subsequently translates into social gains (Fini et al., 2018; Meoli et al., 2019). Moreover, the nature of such ASOs, built on the knowledge, expertise and technology of academics, potentially result in more, economically-important, technology-based firms (Fini et al., 2011). ASOs are particularly important for the development of new, fast-growing science-based industries (OECD, 2002).

Universities are becoming increasingly aware of the potential of these companies and are promoting their creation through various mechanisms. These include mechanisms such as the development of policies to facilitate the surrogation of external entrepreneurs with commercial expertise that collaborate with the academic founders of the ASOs (Klofsten et al., 2019), the establishment of large-scale research infrastructures (LRIs) (Rådberg & Löfsten, 2024), or the emergence of units and organizations that facilitate the attraction and management of talent and the creation of R&D networks to foster ASOs creation, such as TTOs, Industry–University Cooperative Research Centers (IUCRCs) or technological parks or incubators (Lindelöf & Löfsten, 2004; Löfsten & Lindelöf, 2005; Löfsten et al., 2020; Siegel & Phan, 2005). This context favours the collaboration with external actors, such as industry and government, expanding the opportunities for academics (Etzkowitz & Leydesdorff, 2000). Thus, when acting entrepreneurially, academics are influenced by the collaboration that take place in the University-Industry setting, i.e., by UBC activities.

2.3 University-business collaboration (UBC)

UBC is considered to be of great relevance for entrepreneurial behavior at the university and a central aspect of the Entrepreneurial University. Extant literature recognizes the importance of UBC by elevating specific concepts most associated with UBC including cooperative R&D, commercialization of R&D, and entrepreneurial new spin-offs (Davey, 2017). Whilst the entrepreneurial university encompasses collaboration in the quadruple helix of business, government, university and society (Gibb & Hannon, 2006), UBC includes only those cooperative activities between university and industry, whether they be research, education, commercialization or management activities (Davey et al., 2018).

Klofsten and Jones-Evans (2000) refer to these consulting, contract research and educational initiatives as "softer" academic entrepreneurship.

UBC has been defined as "two-way linkages between university and industry entities established to enable the diffusion of creativity, ideas, skills and people with the aim of creating mutual value over time" (Plewa et al., 2013, p365). Activities that have been investigated as UBC activities include *collaborative research* activities including contract research (D'Este & Perkmann, 2011; Davey et al., 2011; Yoshioka-Kobayashi & Takahashi, 2022) and Joint R&D (Borah & Ellwood, 2022; D'Este & Perkmann, 2011); *professional* (Kitagawa & Lightowler, 2013) *and student mobility* (Davey et al., 2018); *collaborative educational activities* such as curriculum design and delivery (Ishengoma & Vaaland, 2016; Orazbayeva et al., 2019), dual studies programs (Davey et al., 2018), hackathons and challenges (Happonen et al., 2022), project-based learning initiatives (Rossano et al., 2016) and lifelong learning; *commercialisation* activities including ASOs (Arvanitis et al., 2008), start-ups (Lee & Lee, 2020), and licensing (Abreu & Grinevich, 2013); and *collaborative management* activities such as governance (Davey et al., 2018) and resource sharing (Yi & Zhang, 2022).

The entrepreneurial behavior and performace is discretionary in nature, and the different activities that can be developed share many motivations (D'Este & Perkmann, 2011). However, whilst a number of papers have identified ASOs as a UBC activity (D'Este & Perkmann, 2011; Galán-Muros et al., 2015; Lam, 2011), there has not been a study that explicitly looked at how UBC affects ASOs. Addressing this gap, this paper takes the view that ASOs are one of several UBC activities academics can undertake, and thus, are driven and affected by UBC related factors. Applying a multidisciplinary approach, the relation between this kind of factors is studied in more depth.

2.4 A multidisciplinary lens in the study of entrepreneurial behavior

Several antecedents influence the decision to behave entrepreneurially, specifically to create an ASO, and their effect has usually been studied separately (Sansone et al., 2021). Based on their nature, a distinction can be made between the following: organizational (e.g., Ramaciotti & Rizzo, 2014); cultural (e.g., Feldman & Desrochers, 2004); policy and ecosystem (e.g., Audretsch et al., 2015); governance (e.g., Meoli et al., 2019); financial (e.g., Ramaciotti & Rizzo, 2014) and personal (e.g., Hayter, 2011) factors.

Neves and Brito (2020) propose a theoretical model that incorporates economic, psychological and sociological antecedents of individual, cultural and organizational nature, and their influence on entrepreneurial activity at the university, specifically, the creation of ASOs (demographic background, educational background, motivations, social capital, human capital, organizational support, quality and climate). The variety of dimensions in this model underscores the need to empirically approach the study of ASOs from a multidisciplinary perspective. So, the background is not only related to economic aspects, but also to psychological and sociocultural components, to avoid a decontextualization of the entrepreneurial phenomenon (Foss et al., 2019). The psychological perspective considers individuals self-conception and perceptions of values and attitudes toward entrepreneurship, while sociology highlights the importance of the context, culture, and social relations of the entrepreneur (Steyaert & Katz, 2004).

Frese (2009) argues that any theory aimed at explaining the entrepreneurial phenomenon must take individual actions as a starting point, since the central element of entrepreneurial activity is the individual who intervenes as active agent. In the same way,

Gorgievski and Stephan (2016) state that psychology is crucial for understanding the entrepreneurial process, since entrepreneurial behavior is conditioned by individuals' attitude and their perceptions of their own values and aptitudes for entrepreneurship. Also, Flores et al. (2024) highlight the relevance of focusing on individual factors to explain the behavior of academics. Krueger et al. (2000) and Thornton (1999) complement this idea by highlighting the relevance of the entrepreneurs' perceptions of the culture and environment in which they are immersed, as entrepreneurship is also a social and context-dependent process. In addition, Patriotta and Siegel (2019) state that "entrepreneurship is embedded in, and fundamentally shaped by, socio-cultural dynamics" (p.1), which gives relevance to the sociological view of the entrepreneurial phenomenon (Ruef, 2015; Thornton, 1999).

There is no current empirical approach that combines variables from both psychological and sociological dimensions studying the relation between them. Most empirical models on antecedents of entrepreneurship within Universities have been developed at the level of intentions (Di Paola, 2020; Fayolle & Liñán, 2014; Kautonen et al., 2015; Liñán & Chen, 2009). The use of the Theory of Planned Behavior (TPB-Ajzen, 1991) in the construction of intention models for entrepreneurship are common. However, TPB considers the antecedents as explanatory and mediating variables to intention, rather than direct explanatory variables for entrepreneurial behavior. Even so, the logic of the use of mediating variables has proven to be relevant and TPB is taken as a reference in this research. So, this study responds to the need of delving into the antecedents of ASO creation from a multidisciplinary approach, presenting a new model that reframes the antecedents of ASOs creation, considering the effect of motivations and social capital as dependent variables and highlighting the role of UBC through three specific dimensions, also of a mixed psychological and sociological nature. The role and relevance of these antecedents is developed in depth in the following section.

2.5 UBC—attitude, cultural support and self-efficacy

First, from a psychological perspective, both attitude and self-efficacy have been considered as crucial aspects in the study of entrepreneurship. The entrepreneurial attitude or the desire to start an entrepreneurial career is related to entrepreneurial intention (Liñán et al., 2011). However, it is also directly associated to entrepreneurial behavior (Ajzen & Fishbein, 1977), as it favors discipline, persistence and commitment to the entrepreneurial activity and facilitates access to key resources such as financing and the development of instrumental networks (NawzadSabir et al., 2019). Previous studies, developed mainly with student samples, agree on a positive relation of entrepreneurial attitude with intentions and behavior (Kautonen et al., 2015; Munir et al., 2019). Also, incorporating attitude into the study of entrepreneurship is crucial as it helps to eliminate biases that may be produced by other variables associated with personality or sociodemographic characteristics such as gender or age. In this vein, attitude is a more robust measure of entrepreneurial behavior and includes feelings, beliefs, and conation towards the activity, in this case UBC (Pihie & Bagheri, 2010). In the same vein, Lechuga et al. (2020) define this attitude as behavioural beliefs that lead to the desirability of acting. This brings up the definition of the first hypothesis:

H1 Academics' attitude towards UBC positively influences ASOs creation.

Self-efficacy, in relation to entrepreneurial activity, is understood as "individuals' confidence in his or her ability to succeed in entrepreneurial roles and tasks" (Camelo-Ordaz et al., 2016, p.263), and is considered a highly relevant entrepreneurial competence (Bacigaupo et al., 2016; Morris et al., 2013). Camelo-Ordaz et al. (2016) state that self-efficacy is one of the strongest predictors of entrepreneurial behavior found in the literature, as it is related with the decision-making process, the management of uncertainty or difficulties and the perseverance in accomplishing tasks; and has a positive correlation with entrepreneurial behavior (Kickul et al., 2008). So, self-efficacy is the sense of one's ability to perform the activity (Ajzen, 2002), in this context UBC, due to the personal perceptions about aspects such as knowledge, skills and accessibility of resources. The positive influence of UBC self-efficacy leads to the second hypothesis:

H2 Academics' UBC self-efficacy positively influences ASOs creation.

Second, entrepreneurial behavior is not only conditioned by individual aspects, but also by sociological variables as the societal conceptions, norms or shared values of a context or region, i.e., the culture. The cultural support for entrepreneurship is recognized as an important factor for entrepreneurship by the Global Entrepreneurship Monitor (GEM) project and its effect on entrepreneurial activity and success has been widely studied (Díez-Martin et al., 2016; Urbano & Álvarez, 2014). From a general perspective, previous studies determine that culture, as other regional characteristics, has an indirect effect on individual entrepreneurial activity (Stuetzer et al., 2014). In relation with UBC, Osiri et al. (2013) state that "within academic institutions a culture of entrepreneurship is the most important factor in generating economic gains from University entrepreneurial activities" (p.1). These authors also highlight the relevance of entrepreneurial culture being shared by people at different positions and levels of hierarchy within the University (e.g., teachers, researchers, University managers). This idea is closely linked to the importance of role models, since social contact with entrepreneurs build culture that predisposes attitudes toward entrepreneurship (Cosci et al., 2021). In the same line, the organizational culture of the university is proven to determine the entrepreneurial activity of scientists (Huyghe & Knockaert, 2014). Also, the context, practices, and shared values of a university department influence the individual level of entrepreneurship of its members and the creation of ASOs (Rasmussen et al., 2014). Therefore, and based on the relevance of the context on individual perceptions towards entrepreneurship (Patriotta & Siegel, 2019), it is also interesting to consider the influence of cultural support for UBC on the other UBC factors of a psychological nature. Thus, three hypotheses are defined:

H3a The cultural support for UBC positively influences ASOs creation.

H3b The cultural support for UBC positively influences academics' attitude towards UBC.

H3c The cultural support for UBC positively influences academics' UBC self-efficacy.

2.6 Motivations

Understanding the motivations for entrepreneurial behavior is critical given its voluntary nature for academics. "Contrary to teaching, engaging with industry constitutes discretionary behavior for academics" (D'Este & Perkmann, 2011, p. 320). Motivations are

considered an aspect of the psychological domain, that can be both intrinsic and extrinsic (Iorio et al., 2017), and of different nature e.g., pecuniary, professional, educational, moral, social or reputational (Miller et al., 2018; Perkmann et al., 2021). Motivations influence individual's present and future perceptions and aspirations and consequently determine their behavior (Ahoba-Sam, 2019). Extant research has shown that certain motivations like curiosity and creativity, societal impact and career promotion increase business related activities in academia (Hillier et al., 2019). Similarly, Sormani et al. (2022) distinguish four categories of motivations that foster the entrepreneurial activity of academics: pecuniary incentives, career advancements, appreciation (by peers, society, University, etc.), and research support. So, the motivations for developing UBC activities comprise the impact at the individual, university and societal-cultural level through its connection to personal beliefs and behaviors. This reasoning leads to establish the following hypothesis:

H4a Motivations positively influence academics' attitude towards UBC.

H4b Motivations positively influence the cultural support for UBC.

H4c Motivations positively influence academics' UBC self-efficacy.

2.7 Social capital

Social capital is a key factor for the development of entrepreneurial intentions and behavior (Weiss et al., 2019), understood as actual and potential "resources —obligations of reciprocity and information— derived from social networks" (Vázquez, 2002, p.129). So, social capital is an enabling factor of UBC (KcKeever et al., 2014), based on social trust and commitment (Lans et al., 2015; Vázquez, 2002). It has a positive relation to entrepreneurial behavior both through its structural dimension (individuals network configuration) and its relational dimension (resources linked to the relations offered by the network) (Lans et al., 2015). Aldridge and Audretsch (2011) state that social capital fosters knowledge and informational flows about how scientific research can be commercialized, whilst Walter et al. (2006) highlight that ASO's success is related to their network capability. In the same line, Hayter (2016) show how social networks bring academics closer to market, and Shane and Stuart (2002) state that founder's social capital contributes positively to new venture performance. So, academics participation in social networks increase the access to resources that helps developing UBC activities, also enhancing their entrepreneurial spirit, positive attitudes toward entrepreneurship and entrepreneurial performance (Chen et al., 2018; McKeever, 2014). The relevance of social capital based on the relations between academics and business leads to the definition of the last three hypotheses:

H5a Social capital positively influence academics' attitude towards UBC.

H5b Social capital positively influence the cultural support for UBC.

H5c Social capital positively influence academics' UBC self-efficacy.

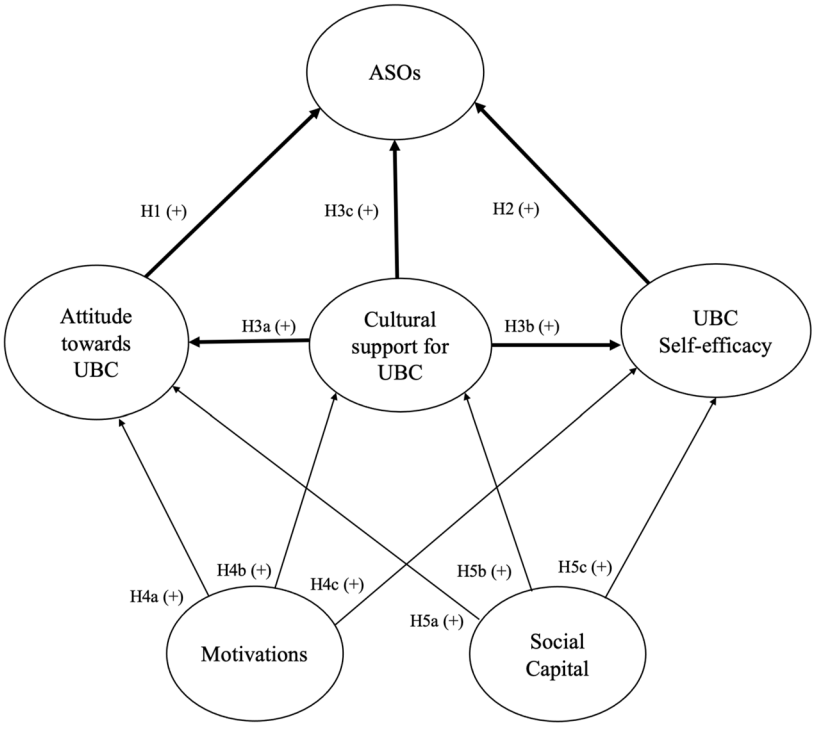
Based on the theoretical framework and the relations derived from the hypotheses, a model is proposed—The UBC-ASOs Model (Fig. 1), which highlights the relevance of UBC for the creation of ASOs. Thus, the model shows the effect of the three dimensions of

UBC on ASOs creation (upper part of the model), as well as the influence on UBC of two antecedents broadly linked to entrepreneurial activity by previous studies (lower part of the model). The direct effects of the antecedents on ASOs creation are not considered since the purpose of this research is to focus on the direct impact of UBC; even though it could be a subject of analysis in future studies.

3 Methodology

3.1 Sample, measures and variables

To gather information from academics working in European Universities, a cross-sectional research design was utilized in this study. A comprehensive online questionnaire was designed to quantitatively collect reliable data on the state of the collaboration of academics with business, including the degree to which they are involved in ASOs creation. The survey was translated into 24 languages and distributed via email to scholars from Northern, Southern, Eastern, and Western Europe. All participants could manually select the language of their choice to ensure comprehension was clear. Specific translators with



The sign (+) shows the positive influence linked to the hypotheses, and the arrow the direction of the relation.
The upper part of the model represents the direct relations of the three UBC variables on ASOs creation (with bold arrows ⟶), while the lower part shows the effect of motivations and social capital (with light arrows ⟶)

Fig. 1 The UBC-ASOs Model

understanding of knowledge transfer activities participated in this process, to ensure that specific terms were translated into the appropriate terminology.

The data collection recorded information obtained from 14,316 academic and non-academic staff in 1,967 European higher education institutions. For the purposes of the research topic, the analysis was conducted on a subsample that excluded non-academic staff and included only academics who reported having experience collaborating with UBC in teaching and research activities, resulting in 2,188 responses.

In relation to the characteristics of the sample, it includes mostly Professors (36%), Researchers and lecturers (22%), Associate professors (17%) and Assistant professors (17%), meaning that the responders are quite senior, with 50% being either Professors or Associate Professors. The sample can be geographically grouped considering Western Europe (35%), Southern Europe (24%), Eastern Europe (22%), and Northern Europe (19%). Respondents were more males (68%) than females (32%) mostly ageing between 40 and 59 years (63%). Although lower and higher age groups were also represented (age 30–39: 20% or age 60–69: 12%).

In relation to the career of the respondents, predominantly, they have worked at the university for more than 10 years (71%). Academics with 5 to 10 years of experience also make up a significant part of the sample (18%). The years of experience undertaking UBC is also measured. More than half of the respondents have more than five years of experience collaborating with business (64%). Also, a significant group has undertaken UBC between 2 and 5 years (22%).

In relation to the area of knowledge, the majority belong to Social Sciences (45%), and Technology and Engineering (43%). The remaining work in the field of Medical Sciences (8%) or Humanities (4%). Regarding the characteristics of the universities to which these academics belong, they mostly have between 2,000 and 19,999 students (62%). Still, almost a quarter of the sample belong to bigger universities with between 20,000 and 49,999 students (23%). Smaller universities are also represented (12%). Lastly, in terms of type of university where the academics work, the sample is distributed as follows: traditional university (51%) as opposed to applied (25%), technical (17%) or of other type (7%). The characteristics of the sample are shown in full in Appendix 1.

Respondents were asked to express the extent to which they have been involved in academic entrepreneurship (spinoff creation), on a 10-point Likert scale (1 = not at all, 10 = to a very high extent). To measure the UBC variables another 10-point Likert scale (1 = not at all, 10 = to a very high extent) collected the degree of agreement with a series of statements measuring attitude, self-efficacy, and cultural support. Regarding motivations, respondents were asked to indicate how relevant different motivations are for their collaboration with business. The relevance of the motivations for developing UBC was also measured on a 10-point Likert scale (1 = not at all, 10 = to a very high extent). Finally, to collect data on social capital, the academics answered to the question "How much do the following factors facilitate your collaboration with business?" indicating the relevance of mutual trust, mutual commitment and shared goal on a 10-point Likert scale (1 = not at all, 10 = to a large extent). Table 1 shows the variables and constructs, the dimension (psychological or sociological) to which they belong, their description and items.

3.2 Statistical procedure

Since the aim of the research involves estimating relationships between the observed outcome variable (ASOs) and the latent variables (attitude towards UBC, cultural support

Table 1 Definition of variables and constructs

Variables/Construct	Dimension	Code	Definition	Items
Commitment towards UCB	PSY	UBC A1	The self-assesment about personal responsibility to develop an entrepreneurial career	I believe it is the role of academics to collaborate with business in education
		UBC A2		I believe it is the role of academics to collaborate with business in research
Cultural support for UBC	SOC	UBC CS1	The cultural support for entrepreneurship presents in society expressed through values social norms and attitudes and role models	The regional business sector has a positive attitude towards UBC
		UBC CS2		There is generally a positive attitude towards UBC in mv region
		UBC CS3		There are positive UBC role models at my university
UBC self-efficacy	PSY	UBC SEl	Individuals' confidence in its own ability to suceed in entrepreneurial roles and tasks in terms of knowledge skills and capabilities	I have sufficient business contacts and relations that I could approach for collaborating
		UBC SE2		I have sufficient knowledge of what business need and want
		UBC SE3		I have sufficient skills and knowledge of UBC generally
Motivators	PSY	M1	Diverse aspects that foster and stimulate entrepreneurship at an individual level (reputation, professional achievements moral accomplishments)	Use my research in practice
		M2		Improve my teaching (i.e. the learning experience and skills of students)
		M3		Gain new insights for research
Social Capital	SOC	SC1	Resources linked to the relations offered by a network based on mutual trust, commitment and shared goals	Existence of mutual trust
		SC2		Existence of mutual commitment
		SC3		Existence of a shared goal
ASOs creation	D	ASOs	Academic engagement in entrepreneurial activities, particularly spin-off creation	Extent of the academic's cooperation with business in academic entrepreneurship (e.g., spinoff creation)

Dimension: *PSY* Psychological; *SOC* Sociological; *D* Dependent

for UBC, UBC self-efficacy, motivations, and social capital) Structural Equation Model (SEM) analysis was employed (Bartholomew et al., 2008). The two-stage approach recommended by Anderson and Gerbing (1988) is applied, yielding results on measurement and structural models.

It should be noted that the outcome variable ASOs is an observed variable, and its self-reported nature enables a direct measure of the narrow definition of ASOs creation, aligned with its theoretical interest for this study. However, for a broader definition of the ASOs construct, it will be necessary to collect more data that capture all aspects of the concept to avoid measurement errors or bias. The analysis was carried out using Stata17 Software, applying a maximum likelihood estimation with missing values (MLMV) and including control variables such as academic gender, age, and years of experience working at a university.

3.3 Analysis of potential biases

To mitigate social desirability bias, the survey was conducted anonymously. Participants were encouraged to provide honest responses with the assurance that no answers were inherently correct or incorrect (Podsakoff et al., 2003). To ensure the validity of the findings, we employed Harman's single factor test to evaluate common method variance (CMV) bias (Harman, 1967). An unrotated maximum likelihood factor analysis revealed that the primary factor accounted for only 19.7% of the total variance, well below the 50% threshold, indicating that CMV bias does not significantly impact this study's results (Podsakoff & Organ, 1986).

To address potential non-response bias, we employed a two-step approach. Based on the assumption that individuals who respond reluctantly or significantly later are more likely to share characteristics with non-respondents (Pace, 1939), we divided our sample into two subsets. Those who submitted their responses within the first month were classified as early respondents, while those who responded during the second and final month were designated as late respondents. Out of the 2,188 valid responses, 1,724 (78.7%) were classified as early responses, while 464 (21.3%) were considered late responses. Next, an independent sample t-test (Table 2) was performed across all variables. The results revealed no statistically significant differences between the two groups, suggesting that non-response bias is unlikely to be a substantial concern in this study.

4 Results

4.1 Measurement model

Firstly, the measurement model was estimated through confirmatory factor analysis (Anderson & Gerbing, 1988). The model is informed by five latent variables which showed a structure with only one factor. While three items measured cultural support for UBC, UBC self-efficacy, social capital, and motivations, two indicators adequately measured attitude towards UBC. These indicators were employed as reflective measurements for all constructs, as each item was designed to reflect the underlying latent variable. We acknowledge that factor analysis assumes a reflective model and does not test for formative alternatives, which could be a limitation if the constructs are better represented by formative indicators. To mitigate this, we ensured that our constructs and selection of indicators

Table 2 Non-response bias analysis using independent samples t-test (equal variances assumed)

					Levene's Test for equality of variances		T-test for equality of means		
Latent Variables	Response Type	N	Mean	SD	F	Sig.	t	df	Sig. (2-tailed)
UBCAl	Early respondents	1141	4.04	0.93	0.47	0.495	−1.73	1435	0.084
	Late respondents	296	4.15	0.83					
UBC.A2	Early respondents	1136	4.17	0.82	0.08	0.774	−0.74	1429	0.462
	Late respondents	295	4.21	0.81					
UBC_CS1	Early respondents	1185	3.35	0.90	0.45	0.504	0.03	1498	0.974
	Late respondents	315	3.35	0.86					
UBC_CS2	Early respondents	1192	3.49	0.91	0.76	0.383	0.37	1504	0.712
	Late respondents	314	3.47	0.87					
UBC_CS3	Early respondents	1186	3.79	0.98	0.27	0.603	−0.94	1497	0.348
	Late respondents	313	3.85	0.95					
UBC_SE1	Early respondents	1142	3.62	1.05	1.56	0.212	1.39	1436	0.165
	Late respondents	296	3.52	1.08					
UBC_SE2	Early respondents	1142	3.62	0.96	0.95	0.330	0.92	1436	0.357
	Late respondents	296	3.56	0.99					
UBC_SE3	Early respondents	1134	3.46	0.99	0.63	0.427	1.15	1427	0.249
	Late respondents	295	3.38	1.03					
Ml	Early respondents	1218	7.95	2.15	0.63	0.427	−1.82	1541	0.070
	Late respondents	325	8.19	2.06					
M2	Early respondents	1215	8.17	2.01	0.55	0.459	0.60	1538	0.546
	Late respondents	325	8.09	2.10					
M3	Early respondents	1221	7.86	2.18	2.70	0.101	−1.67	1544	0.095
	Late respondents	325	8.09	2.06					
SCI	Early respondents	1230	8.12	2.06	2.10	0.147	−0.68	1558	0.497
	Late respondents	330	8.20	2.13					
SC2	Early respondents	1233	7.76	2.19	0.70	0.402	−0.98	1559	0.328
	Late respondents	328	7.90	2.32					
SC3	Early respondents	1229	7.98	2.11	0.23	0.630	−1.60	1557	0.111
	Late respondents	330	8.19	2.08					

composing them were theoretically grounded in previous studies (Davey, 2017; Davey & Galán-Muros, 2020; Galán-Muros & Davey, 2017).

Table 3 presents a summary of the SEM measurement model, with the items for each construct (factors), along with the standardized factor loadings and their associated Z-statistics. The list of composite reliabilities and factor loadings ranging between 0.43 and 0.94 are above or close the recommended minimum of 0.45 (Comrey & Lee, 1992; Stevens, 1992) or 0.5 (Hair et al., 2006). These coefficients indicate that the measurement model performs well, supported by composite reliability and Cronbach alpha values above the recommended minimum of 0.70. Average Variance Extracted (AVE) assess whether the chosen variables for each construct demonstrate adequate convergent validity (Fornell & Larcker, 1981). AVE range from 0.502 to 0.678, with

Table 3 Measurement model results

Composite indicators	Mean	SD	Loading	Z*	α	CR	AVE	VIF
Attitude towards UCB					0.651[a]	0.790	0.672	
UBC_A1	4.06	0.91	0.75	< 0.001				1.87
UBCA2	4.18	0.82	0.86	< 0.001				1.86
Cultural support for UBC					0.742	0.789	0.568	
UBC_CS1	3.35	0.89	0.81	< 0.001				2.34
UBC_CS2	3.49	0.90	0.94	< 0.001				2.51
UBC_CS3	3.80	0.97	0.43	< 0.001				1.24
UBC self-efficacy					0.762	0.775	0.530	
UBC_SE1	3.60	1.05	0.73	< 0.001				1.69
UBCSE2	3.61	0.97	0.82	< 0.001				1.85
UBC_SE3	3.44	1.00	0.64	< 0.001				1.42
Motivators					0.735	0.752	0.502	
Ml	8.00	2.13	0.76	< 0.001				1.74
M2	8.15	2.03	0.82	< 0.001				1.80
VI3	7.91	2.16	0.53	< 0.001				1.35
Social Capital					0.865	0.870	0.678	
SCI	8.13	2.08	0.86	< 0.001				2.59
SC2	7.79	2.22	0.90	< 0.001				2.75
SC3	8.03	2.10	0.73	< 0.001				1.87

SD standard deviation; *α* Cronbach's alpha; *CR* Joreskog's composite reliability; *AVE* average variance extracted

*All loadings are significant at the 0.001 level

[a]Pearson correlation coefficient

a recommended minimum of 0.50 (Fornell & Larcker, 1981), meaning that all of the constructs exhibit good internal consistency and reliability. Furthermore, the analysis of the variance inflation factor (VIF) yielded values below 3, suggesting that neither multicollinearity nor lateral collinearity pose significant concerns in this study (Kock, 2015). This result indicates ranging between 1.24 and 2.75, ensuring the reliability of the statistical results.

Furthermore, discriminant validity was assessed applying the Fornell-Larcker criterion (Fornell & Larcker, 1981). As shown in Table 4 the correlation between each pair of variables did not exceed the square root of their AVE. Additionally, all heterotrait-monotrait (HTMT) ratio values were below the recommended thresholds: less than 0.85 for constructs that are conceptually distinct and below 0.90 for those that are conceptually similar (Hair et al., 2019). These results jointly support the discriminant validity of the research.

Once the reliability and validity of the measurement model are confirmed, the SEM results show that the model fit the data well, as indicated by the chi-square statistic ($\chi^2 = 7943.42$, df = 150, $p < 0.001$), the root mean square error of approximation (RMSEA = 0.038, pclose > = 0.999), the comparative fit index (CFI = 0.956) and Tucker–Lewis index (TLI = 0.939) (Table 5).

Table 4 Discriminant validity

	I	II	III	IV	V
I UBC A	**0.820**	0.107	0.157	0.375	0.173
II UBC CS	0.005	**0.754**	0.241	0.126	0.179
III UBC SE	0.024	0.036	**0.728**	0.168	0.068
IV Motivators	0.113	0.011	0.039	**0.706**	0.303
V SC	0.028	0.029	0.011	0.093	**0.823**

Heterotrait-monotrait ratio over the diagonal (italics). Fornell-Larcker criterion: square root of average variance extracted values in diagonal (bold) and construct correlations below the diagonal

Table 5 Goodness of Fit

Fit statistic	Value
Likelihood ratio	
chi2_bs(150)	7943.42
$p >$ chi2	0.000
Population error	
RMSEA	0.038
pclose	> 0.999
Baseline comparison	
CFI	0.956
TLI	0.939

4.2 Structural model and hypotheses testing

Overall, the results demonstrate that most of the relations tested in the SEM model are positive and statistically significant. The exceptions are H3b and H5c which lead to the rejection of those hypotheses. Still, none of the rest of hypothesis tested (See Fig. 1) can be rejected. So, according to the results almost all the latent variables are specified as predictors of ASOs. While attitude towards UBC, cultural support for UBC and UBC self-efficacy have a direct positive influence on ASOs, motivations and social capital are indirectly positively associated with ASOs by the endogenous variables of the model.

UBC self-efficacy is the latent variable with higher direct influence on ASOs (0.20). The model indicates a lower direct effect of cultural support for UBC (0.11) and attitude towards UBC (0.08). Regarding the effect of cultural support on the other UBC variables, it presents a statistically significant and positive effect on self-efficacy (0.18). Motivations have a higher influence on attitude towards UBC (0.33) and on UBC self-efficacy (0.21) than on cultural support for UBC (0.08). Likewise, social capital presents a statistically significant and positive relation with cultural support for UBC (0.15) and attitude towards UBC (0.09), although the association is not significant with UBC self-efficacy. Table 6 shows the values that lead to the acceptance/rejection of the hypotheses.

Examining the factors deemed to foster ASOs, the fact that academics' own psychological perception of their capability to undertake UBC and their positive attitude towards it are antecedents is not surprising at first glance; i.e., UBC self-efficacy factors, such as possessing sufficient knowledge of business needs, sufficient skills and

Table 6 Path analysis results

Hyp	Path		Relationship	Standardised path coefficients		Support
	Impact of	On				
H1	Attitude towards UBC	ASOs	+	0.08	**	Yes
H2	UBC Self-efficacy	ASOs	+	0.20	***	Yes
H3a	Cultural support for UBC	ASOs	+	0.11	**	Yes
H3b	Cultural support for UBC	Attitude towards UBC	+	0.05		No
H3c	Cultural support for UBC	UBC Self-efficacy	+	0.18	***	Yes
H4a	Motivators	Attitude towards UBC	+	0.33	***	Yes
H4b	Motivators	UBC Self-efficacy	+	0.21	***	Yes
H4c	Motivators	Cultural support for UBC	+	0.08	*	Yes
H5a	Social capital	Attitude towards UBC	+	0.09	**	Yes
H5b	Social capital	Cultural support for UBC	+	0.15	***	Yes
H5c	Social capital	UBC Self-efficacy	+	0.03		No

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed)

knowledge about collaboration with industry, and the capability to transfer knowledge have an effect on the likelihood of the academic to engage in ASOs. Another finding is that self-efficacy is also influenced by the cultural support for UBC and the motivations behind collaborating with industry, showing the relevance of both an extrinsic factor such as the context, and an intrinsic individual aspect; highlighting the relevance of considering both psychological and sociological dimensions in the study of ASOs. It is also worth noting that the role of the cultural support for UBC (including positive attitudes for UBC by colleagues, University management, regional business as well as the existence of UBC role models) affects ASOs both directly and indirectly. This is aligned with previous studies on the relevance of culture for ASOs, including peer interest (Tartari & Breschi, 2012), cultural (e.g., Feldman & Desrochers, 2004) and top-level commitment (Anderson et al., 2007).

Additionally, given the positive relations between all UBC variables and ASOs, the results highlight that a predisposition for UBC activities is potentially important for ASOs activity to occur. These findings are aligned with previous literature that has treated ASOs as a form of UBC (e.g., Lam, 2011). UBC self-efficacy of academic entrepreneurs is an important antecedent of ASOs creation in line with Hayter et al. (2018). Nevertheless, there is limited literature that highlights psychological factors such as self-efficacy as explanatory antecedents for entrepreneurial behavior. Studies often use it to explain opportunity identification (e.g., Mira-Solves et al., 2021) or intention (e.g., Prodan & Drnovsek, 2010), rather than actual behavior.

Being motivated to collaborate with industry affects all UBC variables, showing the importance of UBC drivers for stimulating entrepreneurial behaviour, a result established by Galán-Muros and Plewa (2015). The research considers personal and professional motivations in line with Lam (2011), who state that apart from economic issues, academics who undertake entrepreneurship are motivated by many other factors linked to their personal development and their career. Even so, the effect of motivations is stronger on the two variables of the psychological domain (attitude and self-efficacy; 0.33 and 0.21, respectively) than on cultural support (0.08). This may be because of the shared psychological nature of

the variables. This same argument would likewise explain the higher effect of social capital on cultural support for UBC (0.15), both sociological variables. Overall, the results shown by The UBC-ASOs Model (Fig. 2) offers new insights into how both sociological and psychological factors influence ASOs, with UBC playing an essential role.

4.3 Model robustness

To validate the reliability of the SEM results, a bootstrapping technique was applied (Chernick, 2008; Nevitt & Hancock, 2001). This involved generating 1,000 resampled datasets from the original data and evaluating the consistency of the parameter estimates and model fit indices across these resamples. As shown in Table 7, the bootstrapping analysis confirm that the parameter estimates derived from the original SEM analysis are stable and robust.

Furthermore, subgroup analyses were conducted to assess the sensitivity of the findings and investigate whether the relationships between the latent variables remained consistent across diverse subpopulations within the sample. These subpopulations were defined by geographical regions (Northern Europe, Eastern Europe, Southern Europe, and Western Europe) and academic disciplines (SSHH: Social Sciences and Humanities; STEM: Science, Technology, Engineering, and Mathematics). The results presented in Table 8 demonstrate that the relationships between the latent variables were consistently maintained across these diverse subgroups.

The results of the robustness tests, including bootstrapping and subgroup analyses, provide support for the stability and reliability of the SEM findings. These analyses enhance the credibility of the results and contribute to a more comprehensive understanding of the relationships between latent variables and ASOs across diverse subpopulations.

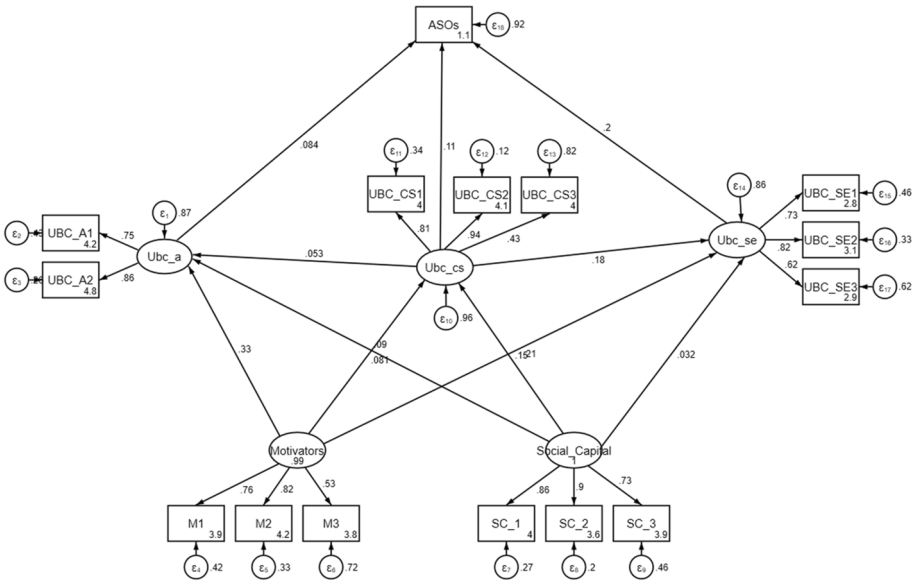


Fig. 2 The UBC-ASOs Model coefficients and results

Table 7 Bootstrapping analysis

Path		Sample	
Impact of	On	Total sample	Bootstrapping[a]
Attitude towards UBC	ASOs	0.084 (0.03) **	0.084 (0.03) **
UBC Self-efficacy	ASOs	0.204 (0.03) ***	0.204 (0.03) ***
Cultural support for UBC	ASOs	0.112 (0.04) **	0.112 (0.04) **
Cultural support for UBC	Attitude towards UBC	0.053 (0.03)	0.053 (0.04)
Cultural support for UBC	UBC Self-efficacy	0.178 (0.03) ***	0.178 (0.05) **
Motivators	Attitude towards UBC	0.329 (0.03) ***	0.329 (0.04) ***
Motivators	UBC Self-efficacy	0.214 (0.03) ***	0.214 (0.04) ***
Motivators	Cultural support for UBC	0.081 (0.03) *	0.081 (0.04) *
Social capital	Attitude towards UBC	0.090 (0.03) **	0.09 (0.04) *
Social capital	Cultural support for UBC	0.146 (0.03) ***	0.146 (0.04) ***
Social capital	UBC Self-efficacy	0.032 (0.03)	0.032 (0.03)
Likelihood ratio			
	chi2_bs(168)	7943.42	7943.42
	$p >$ chi2	0.000	0.000
Population error	RMSEA	0.038	0.038
	pclose	> .999	> .999
Baseline comparison			
	CFI	0.956	0.956
	TLI	0.939	0.939

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed)

[a]reps(1000) seed(1345)

5 Discussion

This paper provides a novel framework, The UBC-ASOs Model, using an extensive international data set, for understanding not just academic entrepreneurial intention, but actual entrepreneurial activity through the creation of ASOs. Whilst previous studies have identified unique findings about what motivates academic entrepreneurial behavior (Hillier et al., 2019; Sormani et al., 2022), the organizational context in which this behavior occurs (Fini et al., 2011), proposed a theoretical concept (see Neves & Brito, 2020) or focused only in national contexts (e.g., Lam, 2011; Muscio et al., 2016), no study has yet grounded ASOs in UBC and brought together sociological and psychological factors to explain the creation of this kind of companies in an international context. Thus, this research answers the call for reframing the study of ASOs, giving the necessary relevance to the academics who develops the entrepreneurial activity within the University, introducing with a broader scope the importance of aspects studied from other disciplines.

Crucially, the results imply that the approach to ASOs by (entrepreneurial) Universities needs a re-think and re-orientation. This is especially true because of the high focus on ASOs in policy (Prodan & Drnovsek, 2010) and the high potential impact they have on local economies (Bercovitz & Feldmann, 2006; Vincett, 2010). ASOs are economically important technology-based firms (Fini et al., 2011) and a vehicle for rapidly evolving knowledge fields (Fini et al., 2011; Prokop, 2023). In this vein, the study suggests

Table 8 Subgroup analysis

Path		Sample						
Impact of	On	Total sample	Northern Europe	Eastern Europe	Southern Europe	Western Europe	SSH	STEM
Attitude towards UBC	ASOs	0.084 (0.03) **	0.021(0.06)	0.121 (0.06)	0.104 (0.05)	0.050 (0.05)	0.061 (0.04)	0.054 (0.05)
UBC Self-efficacy	ASOs	0.204 (0.03) ***	0.236(0.06) ***	0.257 (0.07) ***	0.135 (0.06) *	0.141 (0.05) **	0.129 (0.05) **	0.227 (0.05) ***
Cultural support for UBC	ASOs	0.112(0.04) **	0.169(0.04) ***	0.074 (0.09)	0.147 (0.07) *	0.211 (0.06) ***	0.279 (0.04) ***	0.107 (0.06)
Cultural support for UBC	Attitude towards UBC	0.053 (0.03)	0.163(0.06) *	0.131 (0.07) *	0.08 (0.06)	0.054 (0.06)	-0.033 (0.05)	0.094 (0.05)
Cultural support for UBC	UBC Self-efficacy	0.178 (0.03) ***	0.145(0.07) *	0.113 (0.07)	0.243 (0.07) ***	0.241 (0.05) ***	0.175 (0.05) ***	0.137 (0.05) **
Motivators	Attitude towards UBC	0.329 (0.03) ***	0.311(0.07) ***	0.237 (0.07) **	0.2 (0.07) **	0.394 (0.06) ***	0.305 (0.05) ***	0.353 (0.05) ***
Motivators	UBC Self-efficacy	0.214(0.03) ***	0.25(0.08)	0.217(0.07) **	0.152 (0.07) *	0.140 (0.06) *	0.311 (0.05) ***	0.132 (0.05) *
Motivators	Cultural support for UBC	0.081 (0.03) *	0.099(0.07)	0.067 (0.07)	0.129 (0.07)	0.154 (0.06) **	0.01 (0.06)	0.07 (0.05)
Social capital	Attitude towards UBC	0.090 (0.03) **	0.121(0.07)	0.135 (0.07)	0.061 (0.07)	0.123 (0.05) *	0.076 (0.05)	0.056 (0.05)
Social capital	Cultural support for UBC	0.146 (0.03) ***	0.188(0.06) **	0.222 (0.07) **	0.079 (0.06)	0.049 (0.05)	0.106 (0.05) *	0.223 (0.05) ***
Social capital	UBC Self-efficacy	0.032 (0.03)	0.038(0.08)	0.068 (0.07)	0.117(0.07)	−0.022 (0.05)	−0.065 (0.05)	0.184 (0.05) ***
Likelihood ratio	chi2_bs(168)	7943.42	2032.63	2042.09	2037.41	2360.58	3266.58	3319.28
	$p >$ chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Population error	RMSEA	0.038	0.049	0.052	0.028	0.038	0.036	0.044
	pclose	> .999	0.577	0.325	> .999	0.999	> .999	0.946
Baseline comparison	CFI	0.956	0.944	0.925	0.978	0.947	0.963	0.943
	TLI	0.939	0.922	0.896	0.969	0.926	0.949	0.921

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed)

that ASOs creation, like UBC, is a 'people's game' fundamental to the development of Entrepreneurial Universities. Resultantly, a focus by Universities on supporting the individual person in the collaborative activities, rather than focusing on UBC's transactional nature, is likely to yield improved results. The significance of a combination of sociological and psychological factors on ASOs, which offers a new insight into how the creation of these companies occurs, shows the importance of "playing the man, rather than the ball": a humanistic approach to entrepreneurship at the University. In redefining the Entrepreneurial University through UBC, human behavior and the individual needs to be placed at the heart of the concept of Entrepreneurial University, since entrepreneurship is a human action based on individual perceptions (Frese, 2009).

Whilst specific support could still be available for academics considering ASOs, given the low numbers of ASOs generally (Davey & Galán-Muros, 2020), the results show that a re-definition of Entrepreneurial University policy could be made to focus on UBC generally, and still provide a supportive environment for ASOs. The results suggest that the creation of ASOs is heavily influenced by the broader UBC context and shows the close relation it has with other UBC activities such as commercialization of R&D (Bercovitz & Feldmann, 2006) or even contract research, joint R&D or cooperation in education (Abreu & Grinevich, 2013). A reasoning in line with the research of Rådberg & Löfsten (2024) which highlight that relevance of the "synergistic role" of the university, stating that "entrepreneurial universities had to engage more robustly with external actors to foster practical research applications" (p.334). As such, general policy should focus on UBC, rather than trying to stimulate ASOs per se.

These recommendations provide significant implications and alignment with the Entrepreneurial University literature stream, which embraces a range of 'entrepreneurial' behavior, and a broader understanding of the academic role with respect to entrepreneurial behavior. For this literature stream, the message is clear: encouraging positive attitudes to UBC and supporting UBC activities is likely to lead to a broader and more expansive set of entrepreneurial behavior by academics, at more ASOs in the process. This in turns drives the institutional itself to be more entrepreneurial. The following points of the section delve into the theoretical and practical implications of the research.

5.1 Theoretical contributions

The present study complements the existing research on Entrepreneurial University and, specifically, on ASOs, from a wider perspective demonstrating the effect of relevant antecedents studied by other disciplines. So, the incorporation of psychological and sociological variables enriches the existing knowledge about ASOs antecedents, advancing the theory towards a re-definition of entrepreneurship at University more connected to UBC. In this regard, The UBC-ASOs Model answers a call for developing studies on ASOs antecedents, unlocking the determinants behind the creation of this kind of companies (Gómez-Gras et al., 2008; Sansone et al., 2021).

With respect to theory development and future research for ASOs, a re-consideration is encouraged. Previous studies on entrepreneurial behavior in the University context have analyzed intentions, as a predictor of behavior (Fayolle & Liñán, 2014; Liñán & Chen, 2009), however using intention as a proxy is limited in its applicability. There is a growing request that, in order to make progress in this field, behavior should be the measure of entrepreneurial activity (Lechuga et al., 2020; Weiss et al., 2019). This task is not easy, particularly considering the non-compulsory nature or atypical nature of UBC (Prokop,

2023) and the extensive barriers and complexity of undertaking the activities (Alexander et al., 2020). Even so, this study responds to the call, filling the intention-behavior gap by testing actual entrepreneurial behavior by UBC and ASO measurements (Adam & Fayolle, 2015).

In connection to the above, a further contribution to the Entrepreneurial University research stream is the need to (re-)view the relevance of UBC. The literature supports the importance of UBC for establishing collaborations between academics and business, leading to more connected and impactful Universities, but the present results also highlight its specific role for the creation of ASOs. In this sense, this paper contributes to the knowledge on UBC, re-conceptualizing its importance for the creation of companies by academics. To date there is scarce literature about UBC's psychological and sociological factors and the relation between them.

Finally, the advancements on theory are made from an international perspective, offering a wider scope and more comprehensive evidence, which help to understand the phenomenon in its generality, complementing the existing literature to date more focused on a specific University, region or country (Miranda et al., 2017).

5.2 Management and policy implications

Developing knowledge on ASOs antecedents through The UBC-ASOs Model has important practical contributions for Universities as it helps to design policies and support initiatives and programs to foster a more entrepreneurial institution through the behavior of its academics. In addition, it also has interesting implications for the individuals undertaking UBC and ASO creation. In this sense, the model can also be used as an evaluation and development tool (Fayolle & Liñán, 2014).

From a managerial perspective, the results are highly relevant for the definition of strategies to promote ASOs, helping universities in the transformation process to develop dynamic organizational capabilities (e.g. talented human capital, incentives and resources, new organizational structures) (Klofsten et al., 2019). Kundu and Rani (2008) state that the better we know academics' traits the more we can develop entrepreneurial training and education of quality, to raise entrepreneurial human capital. In this regard, the relevance of strengthening the entrepreneurial motivations and social capital of academics is highlighted, due to its indirect effect. The model indicates that for management initiatives to be effective, both psychological and sociological factors must be considered. When it comes to UBC, on the one hand, it is of interest to design activities that increase self-efficacy and the personal beliefs and desire to develop entrepreneurial initiatives. Simultaneously, contextual aspects and forms of organization that lead to an institutional culture more conducive to entrepreneurship in the University should be improved. While the promotion of psychological aspects is more related to the improvement of training that foster entrepreneurial spirit and knowledge, the promotion of cultural support for UBC needs a change in the managerial style of the University. The culture of entrepreneurship within the institution can be driven through 'top-down' initiatives allocating resources and designing incentives for UBC (in line with Galán-Muros & Plewa, 2015), as well as through infrastructural mechanisms such as the development of science parks and technopoles, offices that support linkages between academia and industry, and University units that support UBC and ASOs (Löfsten & Klofsten, 2024; Löfsten &Lindelöf, 2002). Previous research highlights the role of these units enhancing proximity for the establishment of R&D formal and informal networks (social capital) (Lindelöf & Löfsten, 2004; Löfsten & Lindelöf, 2005), which has

been demonstrated to be an important endowment for early-stage organizations (Shane & Stuart, 2002).

Also, the results suggest that initiatives and policies designed for UBC can generally promote entrepreneurial activity without requiring specific measures for ASOs. Given the relatively low numbers of academics who create ASOs (Davey & Galán-Muros, 2020) and the comparably greater number of academics undertaking UBC or "softer" entrepreneurial activities such as consulting, joint R&D and commercialization of R&D (Klofsten & Jon-Evans, 2000; D'Este & Perkmann, 2011) it would be advisable to focus policy and support to stimulate a range of UBC activities, rather than just the creation of ASOs. In other words, creating specific supports and policies for ASOs are not the only way to foster the creation of these companies. Instead, offering more general support and policies that promote a UBC environment are highly likely to create greater impact, because UBC encompasses a broader group of activities undertaken by a far greater number of academics.

Moreover, the results do not suggest that specific supports and policies for ASOs will be ineffectual. But, if specific policy to stimulate ASOs is deemed desirable, the model indicate that the following support activities offer the best opportunity: (1) promoting the benefits of UBC to academics, (2) creating mechanisms that support the development of mutual trust, commitment and understanding of industry by academics, (3) HEI management signaling a positive attitude to UBC, (4) promoting good-practice cases of UBC by academic peers, (5) support programs for academics to develop knowledge and skills to work with industry and transfer research findings, and (6) support programs which helps academics and facilitates UBC in a trustful and meaningful way.

The UBC-ASOs Model is not only useful for managerial and political purposes, but also for individuals. It constitutes a reference framework for academics who are willing to behave entrepreneurially. It increases the awareness about the multidisciplinarity of factors behind entrepreneurship, helping to destigmatize the consideration of ASOs as a strictly economic activity (Steyaert & Katz, 2004). For example, the proven relevance of social capital, can encourage academics to work on their networks, developing relations both in the University and the industry spheres, based on shared goals, mutual commitment, and trust (Lans et al., 2015; Vázquez, 2002). The model provides academics with information about the relevance of developing UBC as a precursor to ASOs. Finally, it also confers information on the relationship between UBC and ASOs that helps academics to understand the context of university entrepreneurship.

6 Conclusion

This is the first empirical study that simultaneously test the influence of psychological and sociological dimensions on ASOs on an international scale comprising 33 European countries. This study combines both types of dimensions to reflect the importance of individual and social aspects (Neves & Brito, 2020), redefining the study of ASOs through The UBC-ASOs Model. The research demonstrates the importance of both motivational aspects and social capital in the process of formation of entrepreneurial behavior and concludes their influence in different spheres. The positive effect shown by the relations indicates that the greater the academic's motivations to develop UBC, the better attitudes, self-efficacy and cultural support towards UBC. In the same vein, greater social capital (mutual trust, mutual commitment and shared goals), improve the cultural support for UBC and the attitude towards UBC. These results conclude the

relevance of integrating a multidisciplinary approach in the study of ASOs and, overall, in the development of novel knowledge relevant for the Entrepreneurial University. It allows for a broader understanding of the phenomenon to drive entrepreneurial behavior at the University. Following the model, the three UBC factors are in turn positive antecedents for ASOs. So, these results underline the importance of UBC to foster ASOs, calling for further research to deepen the understanding of the relations between these two concepts.

6.1 Limitations and further research

While noting the important contributions made by this study, some limitations are also acknowledged. The self-selection of the sample through an online-based questionnaire might be the largest one. In addition, and despite the use of professional translators who used back and forth translations, there might still be some potential biases in the translations. Other limitations to this research are the potential subjectivity and consideration of different frameworks in the self-assessment of the academics about their level of entrepreneurial behavior– even when Europe is the reference. Regarding future opportunities, whilst this is an international study that allows general conclusions applicable internationally, these results could also be further developed and contextualized. As a next step, to test the impact of context, future studies could replicate the model at regional and national levels, incorporating factors such as political, economic or social conditions or even intrinsic variables of the University.

Also, the results open a wide range of possibilities to advance the knowledge of Entrepreneurial University from an original and multidisciplinary approach. First, to deepen the relation between UBC and ASOs, future research could go a step further and analyze the existence of differences between faculties or areas of knowledge, as it is demonstrated that different fields develop UBC activities and create ASOs to a different extent (Houweling & Wolff, 2020). In this line, previous literature calls for more studies that address University entrepreneurship by differentiating STEM and Social Sciences (Olmos-Peñuela et al., 2014). Second, the creation of an ASO represent academic entrepreneurial behaviour and provide value both internally to the university, and externally to the socio-economic environment and entrepreneurial ecosystem (Fini et al., 2018). But there is not only the measurement of entrepreneurial behaviour or value creation, other aspects such as the survival or success of ASOs could also be measured (Hossinger et al., 2020; Mathisen & Rasmussen, 2019). Addressing these factors in future studies might be an interesting way to advance The UBC-ASOs Model. Third, based on the theoretical model developed by Neves and Brito (2020), considered as a theoretical influence for this study, it would be of great interest to further develop the empirical model presented in this paper considering other antecedents of individual, organizational and institutional nature demonstrated to be important for academic entrepreneurial behavior; such as human capital, competences, personal characteristics (age, gender, educational background…) or organizational support (Fayolle & Gailly, 2015). Finally, this model could also be adapted to other research trends in the topic, such as the intrapreneurial university approach. It allows the incorporation of intrapreneurial capabilities as independent variables, due to their link to the psychological perspective and its importance in the study of entrepreneurial behavior (Guerrero et al., 2021; Klofsten et al., 2021). The inclusion of new independent variables would further develop and increase the value of The UBC-ASOs Model.

Appendix 1: Sample characteristics

Sample characteristics (N = 2,188)			
	N	%	Valid %
Academic position			
Professor	782	35.7	35.7
Associate Professor	374	17.1	17.1
Assistant Professor	376	17.2	17.2
Researcher & lecturer position	483	22.1	22.1
Lecturer (only teaching duties)	113	5.2	5.2
Researcher (only research duties)	60	2.7	2.7
Missing values	0	0.0	
Region of Europe			
Northern Europe	414	18.9	18.9
Eastern Europe	484	22.1	22.1
Southern Europe	516	23.6	23.6
Western Europe	774	35.4	35.4
Missing values	0	0.0	
Gender			
Male	1005	45.9	67.7
Female	480	21.9	32.3
Missing values	703	32.1	
Age			
20—29	42	1.9	2.8
30—39	302	13.8	20.3
40—49	509	23.3	34.2
50—59	427	19.5	28.7
60—69	183	8.4	12.3
70 +	25	1.1	1.7
Missing values	700	32.0	
Years working at university			
0 to < 1	12	0.6	0.8
1 to < 2	30	1.4	2.0
2 to < 5	121	5.5	8.2
5 to < 10	273	12.5	18.4
10 to < 20	578	26.4	39.0
20 +	470	21.5	31.7
Missing values	704	32.2	
Years involved in UBC			
0 to < 1	78	3.6	5.3
1 to < 2	130	5.9	8.8
2 to < 5	322	14.7	21.8
5 to < 10	384	17.6	26.0
10 to < 20	369	16.9	25.0
20 +	194	8.9	13.1

Sample characteristics (N = 2,188)			
	N	%	Valid %
Missing values	711	32.5	
Area of Knowledge			
Social Sciences	761	34.8	45.0
Technology and Engineering	729	33.3	43.1
Medical Sciences	133	6.1	7.9
Humanities	61	2.8	3.6
Other	6	0.3	0.4
Missing values	498	22.8	
Number of students within university			
1—1,999	164	7.5	11.5
2,000—9,999	484	22.1	34.0
10,000—19,999	397	18.1	27.9
20,000—49,999	326	14.9	22.9
50,000 +	54	2.5	3.8
Missing values	763	34.9	
Nature of university			
University (traditional / general)	1106	50.6	50.8
University of applied sciences	551	25.2	25.3
Polytechnic university / Technical university	360	16.5	16.5
School of arts	14	0.6	0.6
College of education	34	1.6	1.6
Other	114	5.2	5.2
Missing values	9	0.4	

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Declarations

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Authors and Affiliations

Todd Davey[1] · Sofía Louise Martínez-Martínez[2] · Rafael Ventura[2] · Victoria Galán-Muros[3]

✉ Sofía Louise Martínez-Martínez
sofia.martinez@uma.es

Todd Davey
todd.davey@imt-bs.eu

Rafael Ventura
rventura@uma.es

Victoria Galán-Muros
v.galan@unesco.org

[1] IMT Business School, Paris, France & International Centre for Knowledge Alliance (ICKR), University of Technology, Sydney, Australia

[2] Faculty of Economics and Business Sciences, University of Malaga, Malaga, Spain

[3] UNESCO International Institute for Higher Education, Paris, France