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Incorporating non-academics in academic spin-off entrepreneurial teams: Impacts on innovation and commercial performance

ABSTRACT (103 words)

To enhance the development of academic spin-offs, surrogate (external) entrepreneurs are often integrated in the core team of academics. However, the literature also documents potential faultlines between academics and non-academics that hamper firm performance. Based on a sample of 164 Italian academic spin-offs, this study investigates the importance of faultline intensity in this context and the effects on academic spin-off innovation and commercial performance. The findings confirm that surrogate entrepreneurs generally make a positive contribution to academic spin-off performance but may become counter-productive when their presence overpowers academics and contributes to the emergence of strong faultlines. Implications for theory and practice are discussed.

Keywords: academic spin-off; commercial performance; diversity; entrepreneurial team; faultline theory; innovation.

1. Introduction

Academic spin-offs (ASOs) are a particular species of new technology-based firm that emerges from the transfer of a core technology developed at a public or university-based research institution (Clarysse et al., 2005, Nicolaou and Birley, 2003). The entrepreneurial team generally includes the academic(s) who developed the technology, but in some cases, external entrepreneurs take over and build a company around the technology (Kassicieh, 2011, Nicolaou and Birley, 2003). Academic entrepreneurship's microfoundations and success reside in the entrepreneurial team (Knockaert et al., 2011, Taheri and van Geenhuizen, 2016, Huynh et al., 2017, Wright, 2014)—that is, 'the group of individuals that is chiefly responsible for the strategic decision making and ongoing operations of a new venture' (Klotz et al., 2014, p. 227).

In their recent review of the role of entrepreneurial teams in ASOs, Nikiforou et al. (2018) found that existing research has focused mainly on the human and social capital of team members. This aligns with the general literature on entrepreneurial teams, which focuses mainly on upper echelons theory and strategic management to examine the impact of teams on new venture performance (Klotz et al., 2014, Ben-Hafaïedh, 2017). Focusing on the composition of the top team, this approach emphasizes the importance of diversity of cognitive frames for superior performance (Hambrick and Mason, 1984). However, ASO entrepreneurial teams have idiosyncratic human capital; generally built around academics (Chiesa and Piccaluga, 2000), they are larger and more homogeneous than other new technology-based teams, with a high concentration of research and development experience and a lack of commercial experience (Wright et al., 2007a, Ensley and Hmieleski, 2005, Franklin et al., 2001, Czarnitzki et al., 2014, Colombo and Piva, 2012). Like any new technology-based firm, ASOs must blend research and market orientation (Visintin and Pittino, 2014, Debackere, 2000), which is more challenging for ASOs because of their non-commercial origins and team profile. While existing research has confirmed the overall impact of ASO entrepreneurial teams on new venture performance, the evidence from the general entrepreneurial team literature is inconclusive (Jin et al., 2017) in relation to most of the investigated dimensions (e.g. entrepreneurial experience, industry experience, team size) (Nikiforou et al., 2018). Although informative, this research has two main shortcomings. First, to compensate for the lack of commercial experience in ASO entrepreneurial teams, efforts are generally made to incorporate non-academics in the team (Vanaelst et al., 2006); this is theoretically relevant, as these so-called 'surrogate' (external) entrepreneurs (Franklin et al., 2001) add cognitive diversity (as per upper echelons theory) and market orientation, skills and expertise (as per human capital theory). As ASOs tend to perform less well than their independent counterparts (Ensley and Hmieleski, 2005), it seems possible that the traditional focus on the positive aspects of cognitive diversity and added human capital may neglect the negative consequences as described by faultline theory in particular. This theory extends the classical view of team diversity by introducing the notion of group faultlines, defined as hypothetical dividing lines that split a group into subgroups (Thatcher and Patel, 2012). We contend that the presence of non-academics in an ASO entrepreneurial team may create a faultline that separates them from the core team of academics, leading to negative team outcomes (Visintin and Pittino, 2014, Rasmussen and Wright, 2015). A second limitation of the existing research is that measures of ASO performance fail to take account of the differing orientations of these two subgroups. In studies of ASO survival (Nikiforou et al., 2018), the evidence suggests that while the academics are more oriented towards research outcomes (innovation), the non-academics tend to focus more on commercial performance (Visintin and Pittino, 2014).

The present study explores the respective impacts of these subgroups on innovation and commercial performance. Based on a sample of 164 Italian ASOs, the strength of faultlines between the two subgroups was found to have significant explanatory power in terms of performance outcomes, and the findings confirm the relevance of the two distinct performance measures. The article contributes to an emerging research stream that addresses calls to examine team diversity from different perspectives beyond the variety-based approach (Harrison and Klein, 2007, Carton and Cummings, 2012), including traditional approaches (see Hambrick, 2007) and recent research on ASO entrepreneurial teams (Visintin and Pittino, 2014, Ben-Hafaïedh et al., 2018). The present findings suggest that a combined approach is important and further clarify the nature and impacts of variations in faultline strength.

The next two sections outline the theory and the derived hypotheses. There follows an account of the data, sample, analysis and results. The article concludes with a discussion of the findings, along with theoretical and practical implications and directions for future research.

2. Understanding ASOs

2.1. Two social entrepreneurial identities

The importance of social identity theory in organizations is widely acknowledged (Ashforth and Mael, 1989). According to Tajfel and Turner's (1986) social identity theory, 'individuals perceive others as belonging to subgroups that represent shared values and social characteristics' (Carton and Cummings, 2012, p. 444). Individuals rapidly self-categorize in ways that accentuate their similarities with ingroup members and differentiate them from outgroup individuals or other groups (Abrams and Hogg, 2006); in other words, individuals develop ingroup and outgroup stereotypes (Riesch, 2010).

The ASO literature characterizes academics as research- or innovation-oriented (Vanaelst et al., 2006). In general, they are less inclined to engage with the commercial world (Vohora et al., 2004, Iacobucci et al., 2011), as they come from a historically non-commercial environment and may fail to appreciate or even disapprove of entrepreneurial endeavours (Nikiforou et al., 2018, Miozzo and DiVito, 2016). To the extent that they do become involved in such endeavours, they are less likely to be motivated by extrinsic rewards such as money or recognition (Escobar et al., 2017). Instead, they are likely to be more interested in developing the best possible solution, based on the logic of scientific research (Iacobucci et al., 2011). In contrast, non-academics are likely to be more focused on bringing the technology to market and on sales (Vanaelst et al., 2006). For academics, it is the technology that drives a start-up's success; for non-academics, success depends more on market factors (Kassicieh, 2011). Moreover, academics' conception of science as an end in itself diverges from the more 'economic' conception of non-academics, who see science as a means to an end (Nlemvo Ndonzuau et al., 2002). As academics tend to take active steps to preserve their academic role identity even when participating in technology transfer (Jain et al., 2009), it is reasonable to infer that, in an ASO entrepreneurial team comprising academics and non-academics, the two form distinct identity-based subgroups (Carton and Cummings, 2012). It follows that team members identifying with one or other group will differ in their views of entrepreneurship and will behave in ways considered congruent with their social entrepreneurial identity (Gruber and MacMillan, 2017, Alsos et al., 2016). In particular, we contend that academics are likely to be more concerned with research outcomes (innovation) while non-academics are more focused on market/commercial outcomes.

2.2. Diversity and performance

When founded, ASOs are often unbalanced in terms of experience (Vanaelst et al., 2006); while the academic core delivers a high concentration of research and development capability, 'sectoral experience in commercial functions such as product management or business development is completely lacking' (Wright et al., 2007a, p. 139). For that reason, efforts are generally made to incorporate non-academic outsiders with business/commercial experience in the entrepreneurial team (Vanaelst et al., 2006, Grandi and Grimaldi, 2003). In the ASO literature, as in the general entrepreneurial teams literature, diversity is considered primarily in terms of variety (Harrison and Klein, 2007), based on upper echelons theory (Hambrick and Mason, 1984), which assumes that high levels of cognitive diversity improve performance

(Homberg and Bui, 2013). On this view, the cognitive diversity introduced by mixing academics and non-academics is a positive factor, as the combination of differing experiences, expertise and perspectives promote creativity, innovation and problem solving, leading to superior performance (Hambrick and Mason, 1984). However, team diversity may also contribute to coordination and communication problems, making 'variety' a double-edged sword (Díaz-Fernández et al., 2019, Harrison and Klein, 2007). We contend that this is especially true of ASO entrepreneurial teams that mix business professionals with a core team of academics (Fryges and Wright, 2014), making it necessary to take account of another type of diversity beyond 'variety'—that is, 'separation', which is a cornerstone of faultline theory (Harrison and Klein, 2007, Carton and Cummings, 2012).

In the literature, ASO entrepreneurial teams are widely depicted as a specific type, involving two distinct identity-based subgroups. While some teams are academics-only or non-academics-only (Ben-Hafaïedh et al., 2018, Kassicieh, 2011), we are more interested here in entrepreneurial teams comprising both. The mix of these contrasting identities may create a faultline—that is, a 'hypothetical dividing line that may split a group into subgroups based on one or more attributes' (Lau and Murnighan, 1998, p. 328)—that creates a schism within the team. Although originally addressing demographic attributes, faultline theory also acknowledges the significance of deep-diversity attributes (Lau and Murnighan, 1998); in other words, it is important to consider characteristics used by team members to define in-group and out-group clustering (Ndofor et al., 2015).

According to research based on faultline theory, faultlines can have negative impacts on team outcomes (Thatcher and Patel, 2012). In the context of ASOs, Rasmussen (2011, p. 460) referred to 'the inherent disputes between the academic culture and the commercial culture' (2011, p. 460), and Nikiforou et al. (2018, p. 96)) argued that 'balancing these two very distinct but equally important mindsets can hinder knowledge sharing, create tensions in the team, and create communication and collaboration problems' (p. 96). Examining faultlines in terms of the proportion of academic and non-academic members in an ASO entrepreneurial team, Visintin and Pittino (2014) found that heterogeneity (termed "profile differentiation") has a positive impact on performance as measured by sales and employment when certain characteristics promote integration between subgroups (e.g. less status disparity within academic subgroups, common membership of the same research team, similar previous work experience).

However, analyses of disciplinary backgrounds have yielded inconsistent results. Ben-Hafaïedh et al. (2018) examined the impact on ASO performance of the three main team configurations (exclusively academic, exclusively non-academic, mixed), as well as extended teams with members from public research institutions and industrial partners. They found that the dual configuration was best overall, and that extended entrepreneurial teams only enhanced certain outcomes (innovation or sales) for certain team configurations. These studies serve to confirm the relevance of faultline theory in the present context, as well as the relevance of the distinction between academic and non-academic subgroups. Here, we build on and deepen this research to examine the impact of faultline strength on the two main criteria of ASO success: innovation and sales.

3. Hypotheses

When examining the impact of entrepreneurial team characteristics on ASO performance, existing research has focused on the new venture's survival (e.g., Criaco et al., 2014, De Cleyn et al., 2015, Shane and Stuart, 2002) and on ASO revenue and revenue growth (e.g., Ensley and Hmieleski, 2005, Lundqvist, 2014). Measures of revenue and revenue growth are generally used when comparing ASOs and independent startups, and ASOs have generally been found to perform less well than their independent counterparts (Ensley and Hmieleski, 2005). We argue here that it is important to examine performance outcomes with regard to the respective identities of ASO team subgroups (see section 2.1 above). For example, Diánez-González and

Camelo-Ordaz (2016) found that a higher proportion of non-academics in the team was associated with a stronger entrepreneurial orientation. This is not to say that academics are uninterested in commercial outcomes, or that non-academics are uninterested in research outcomes, but their differing emphases tend to reflect their contrasting social entrepreneurial identities. In general, a team that includes non-academics will be more oriented towards commercial performance and (controlling for team size) is likely to devote fewer human capital resources to research. On that basis, we formulated the following hypotheses.

H1. An academics-only entrepreneurial team has (a) a positive effect on ASO innovation and (b) a negative effect on ASO commercial performance.

H2. The presence of non-academics in the entrepreneurial team has (a) a negative effect on ASO innovation and (b) a positive effect on ASO commercial performance.

The inclusion of non-academics in ASO entrepreneurial teams is commonly seen to enhance performance (e.g., Lundqvist, 2014). However, studies based on faultline theory (e.g., Lau and Murnighan, 2005) have suggested that strong faultlines can cause more intragroup conflict and poorer outcomes in terms of group learning, psychological safety, satisfaction, and expected group performance when compared to groups with weak faultlines. On that basis, we propose that the stronger the presence of non-academics within a mixed team, the greater the likelihood of strong faultlines that will negatively impact the relationship between academic presence and innovation (moderating effect). On that basis, we formulated the following hypothesis.

H3. The stronger the presence of non-academics in an ASO entrepreneurial team, the weaker will be the impact of the core team of academics on innovation.

As H3 examines the impact of a stronger non-academic presence as reflected in increasing equity detention in the direct relationship between academics and research outcomes (innovation), we tested for a moderating effect.

Turning now to consider commercial performance, which is widely regarded as the primary concern of non-academics (as compared to academics), we would expect to find a strong direct relationship between non-academic presence and commercial performance. To examine the impact of a strong faultline, we argue that an entrepreneurial team dominated by non-academics (as reflected in equity detention) will be subject to a strong faultline that negatively impacts commercial performance, so offsetting any positive impact predicted by diversity-as-variety theories (e.g. upper echelons theory). On that basis, we formulated the following hypothesis.

H4. An entrepreneurial team strongly dominated by non-academics will have a negative effect ASO commercial performance.

4. Method

4.1. Data and sample

The empirical analysis draws on a unique dataset of Italian ASOs developed by the Centre for Innovation and Entrepreneurship at the Università Politecnica delle Marche and Scuola Sant'Anna in collaboration with Netval (the Italian association of technology transfer offices in universities and other public research institutions). The dataset includes the whole population of Italian ASOs for the period 2000–2007 (N = 290).

We examined balance sheet data and ownership and governance information for each ASO, focusing specifically on the founding individuals (about 1500) constituting the entrepreneurial teams. As a first step, we separated academics from non-academics (Diánez-González and Camelo-Ordaz, 2016, Visintin and Pittino, 2014); then, using data from the Italian Ministry of Education, University and Research (MIUR), we analysed the specific roles of all academic founders. In the case of non-academic founders, we collected career information from the Internet. Finally, we gathered data from the Orbit database on patents and licenses registered by each spin-off.

After removing missing values, the final dataset included 164 academic spin-offs. As the Chamber of Commerce reports, missing values are mainly a consequence of random delays in delivery of financial reports rather than of any systemic characteristics of relevance here.

4.2. Measures

Dependent variables. Commercial performance was measured as sales growth rate between the second and fourth year following spin-off inception (mean = 1.17, SD = 2.51). We selected this interval because income statement data were available every second year and in order to exclude non-systematic phenomena that may have biased early sales data. Measuring independent variables at time of inception also mitigated the risk of endogeneity caused by simultaneity and reverse causality where dependent and independent variables are measured simultaneously (Verbeek, 2012, Bryman, 2012).

Innovation was measured in terms of the number of patents and licenses registered from time of inception (mean ≈ 2, SD ≈ 5), which is a widely used indicator of research productivity (Zucker and Darby, 2001, van der Steen et al., 2013, Stephan, 2014, Chen and Wang, 2008). We adjusted this variable for spin-off age to obtain a per-year indicator of innovation.

Explanatory and moderator variables. We considered three dummy variables: for entrepreneurial teams composed of academics only (24% of observations); for entrepreneurial teams including non-academics (76% of observations); and for entrepreneurial teams including academics (95% of observations). Additionally, we included a variable indicating the share of capital contributed by non-academics as a measure of their relative power in the entrepreneurial team (mean ≈ 26%, SD ≈ 27%). A further variable indicated whether non-academics' share was greater than 50%, making them controlling shareholders (16% of observations).

Control variables. Team size as measured by number of members (mean ≈ 5, SD ≈ 3) was used as a proxy for human capital (Hsu, 2007); a larger entrepreneurial team might be expected to enhance access to resources (Colombo and Grilli, 2005), so improving performance and stimulating growth (Zimmerman, 2008). We controlled for firm size as measured by the natural logarithm of total assets (average value of total assets in levels = €208,431.85), as greater resources may positively impact performance (Beckman et al., 2007). We used a dummy variable to indicate the presence of venture capitalists (9% of observations). While venture capitalists may enhance access to external resources and competencies (Colombo and Grilli, 2009), their presence may also introduce a faultline (Lim et al., 2013). Industry-specific heterogeneity was accounted for by a set of dummy variables based on the ATECO/NACE industry classification. The three most strongly represented industries were (1) professional, scientific and technical activities (about 63% of observations); (2) manufacturing (about 20% of observations) and (3) information and communication (about 15% of observations). A set of dummy variables indicating year of spin-off inception was included in the models to control for potential temporal effects. Table 1 summarises the descriptive statistics.

Insert Table 1 about here

4.3.Empirical Strategy and Models

To test the hypotheses, we used a regression-based approach based on a model of the form

$$y_i = \alpha + \theta s_i + \gamma m_i + \delta s_i m_i + \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i \qquad (1),$$

where y_i denotes the dependent variable for spin-off i; s_i is an explanatory variable of interest; m_i is a moderator variable; $\mathbf{x}_i$ a vector of control variables and ε_i is a zero mean stochastic term. In Equation 1, α, θ, γ, δ and (the vector) $\boldsymbol{\beta}$ indicate parameters (vector of parameters).

We used the model in Equation 1 to test all of the hypotheses. For each hypothesis, we were especially interested in the two parameters θ and δ; the former indicates the effect of the independent variable of interest on the dependent variable when the moderator variable is zero, and the latter indicates the effect of the moderator variable on the relationship between the independent variable of interest and the dependent variable. Where a hypothesis did not require the inclusion of a moderator variable (i.e. H1, H2, H4), γ and δ were set to zero, and the parameter θ directly measured the effect of the independent variable of interest on the dependent variable.

For empirical estimation of the model in Equation 1, it was necessary to treat the two dependent variables differently. To test the hypotheses about commercial performance, Equation 1 was directly estimated using Ordinary Least Squares (OLS), as sales growth is a continuous variable. In these models, robust standard errors were used to account for potential heteroscedasticity.

However, it was problematic to estimate Equation 1 using OLS to explain innovation as measured by number of patents and licenses, which is a count variable with a low modal value, in which each observation can take only non-negative integer values. The characteristics of the dependent variable forced us to deviate from a simple linear model estimated by OLS, as the latter model can predict negative values and is not generally appropriate for highly non-normal data. The most popular model for count data is the Poisson regression (Wooldridge, 2010, Verbeek, 2012), in which the dependent variable follows a Poisson distribution, and the logarithm of its expected value is modelled as a linear combination of the independent variables.

As the number of patents and licenses come from ASOs of different ages, the dependent variable had to be corrected for spin-off age, adjusted for each observation (because older spin-offs have had longer to produce patents and licenses). In Poisson regression models, this adjustment is handled by an offset variable. Using the logarithm of spin-off age as an offset variable, this became a model based on rate of patents and licenses per year rather than on a simple (and possibly misleading) count (Hilbe, 2011). Estimation of Poisson regression models is based on maximum likelihood. To deal with potential over-dispersion, we used sandwich standard errors (Cameron and Trivedi, 2005, Zeileis et al., 2008) as a simpler but consistent alternative to quasi-Poisson and/or negative binomial regression models (for more detail, see Zeileis et al., 2008).

5. Results

To test hypothesis H1(a), we estimated two models (models 1 and 2 in Table 2); both were Poisson regression models based on number of patents and licenses and adjusted for spin-off age. While model 1 included all control variables, model 2 excluded industry and year fixed effects to avoid excessive dummy proliferation. In addition to the control variables, the two models included a dummy variable for entrepreneurial teams composed of academics only (academics-only ET). As shown in Table 2, the results of models 1 and 2 show a positive relationship between entrepreneurial teams composed of academics only and innovation, supporting H1(a). Among the control variables, only firm size seems to play a role. According to an unreported Variance Inflation Factor (VIF) analysis, there were no multicollinearity problems.

Insert Table 2 about here

To test H1(b), we estimated models 3 and 4 (Table 3). We found support for this hypothesis, which predicts that an academics-only entrepreneurial team would register lower commercial performance.

Insert Table 3 about here

To test H2(a), we estimated models 5 and 6 (Table 4). The results support the hypothesis that the presence of non-academics in an entrepreneurial team has a negative effect on innovation.

Insert Table 4 about here

H2(b) was also supported, as models 7 and 8 (Table 5) indicate that the presence of non-academics in the entrepreneurial team has a positive effect on commercial performance.

Insert Table 5 about here

Models 9 and 10 (Table 6), which tested H3, correspond to the model in Equation 1 as described in the Empirical Strategy and Models section. Confirming H3, the two models show that greater power of non-academics (as proxied by percentage equity shareholding) has a negative moderating effect on the relationship between presence of a core team of academics and innovation.

Insert Table 6 about here

Consistent with H4, the results in Table 7 show a negative relationship between commercial performance and entrepreneurial teams in which non-academics are controlling shareholders.

Insert Table 7 about here

6. Discussion

We have argued here that academics and non-academics in ASO entrepreneurial teams constitute two 'identity-based subgroups' (Carton and Cummings, 2012), and that this specific composition requires consideration of faultline theory alongside traditional approaches to team diversity. We found that a team comprising academics only had a positive impact on innovation and a negative impact on commercial performance (H1). This aligns with earlier evidence regarding the effectiveness of ASOs on the research and development dimension (Powers and McDougall, 2005, Iacobucci et al., 2011, Druilhe and Garnsey, 2004, Vohora et al., 2004) and their weaknesses on the commercial dimension (Wright et al., 2007a, Vohora et al., 2004). We also found that including non-academics (with their market orientation) in the entrepreneurial team impacted negatively on research outcomes while enhancing commercial outcomes (H2), again demonstrating the relevance of the two performance measures.

Secondly, the findings indicate that it is important to take account of faultline theory when deciding to integrate surrogate entrepreneurs (non-academics) in the entrepreneurial team to enhance commercial performance. Indeed, the dominant presence of non-academics reduces the positive impact of the core academic team on innovation (H3). Furthermore, while the strong presence of non-academics in the entrepreneurial team should have a positive impact on commercial performance (especially according to upper echelons theory), the results instead show a negative impact (H4). We contend that this negative effect reflects the substantial faultline triggered by the strong presence of non-academics.

6.1.Implications

The present article contributes to an emerging research stream addressing calls to assess team diversity from different perspectives beyond mere variety (Harrison and Klein, 2007, Carton and Cummings, 2012), including traditional approaches (see Hambrick, 2007) and recent research on ASO entrepreneurial teams (Visintin and Pittino, 2014, Ben-Hafaïedh et al., 2018). In their recent literature review, Nikiforou et al. (2018) called for research exploring the composition of ASO entrepreneurial teams comprising members with differing identities (i.e. scientific vs. commercial). In their review of ASO development, growth and performance, Mathisen and Rasmussen (2019) also called for the incorporation of this identity perspective when examining team-level determinants. The present research clearly addresses these issues.

These findings have a number of theoretical and practical implications. First, there are implications for studies of team composition. Our results highlight the need to take account of faultline theory alongside more traditional approaches to diversity in cases where different subgroups can be identified within a team. While faultlines have previously been explored mainly from a demographic perspective, this paper addresses separation-based faultlines and identity-based subgroups (Harrison and Klein, 2007, Carton and Cummings, 2012). Our research also highlights the importance of faultline strength. Finally, these findings may offer some guidance and insight to academic entrepreneurs and others with an interest in assisting the formation of ASO entrepreneurial teams or in predicting their future performance, such as the staff of technology transfer offices (Berbegal-Mirabent et al., 2015). According to Wright et al. (2007b, p. 800), 'A central issue for academic entrepreneurship activities is to integrate scientific knowledge with the commercial knowledge to enable a spin-off to develop'. The literature suggests that this issue should be addressed from one of two main perspectives. (a) Avoid surrogate entrepreneurs because of the high risk of failure; instead, it may be more useful (for example) to coach the lead academic for the CEO position (Vanaelst et al., 2006). (b) Integrate surrogate entrepreneurs (Lundqvist, 2014). Our research tends to support the second path; overall (as suggested by traditional approaches to team diversity), surrogate entrepreneurs are a good thing, but the effect may be counter-productive if their presence overpowers the academics and contributes to the emergence of a strong faultline.

6.2. Limitations and future research

This study has a number of limitations, in turn suggesting avenues for future research. A first limitation is that we inferred a social entrepreneurial identity from academic/non-academic status. While this proxy has been explained (see theory section) and was successfully deployed in previous research (Ben-Hafaïedh et al., 2018, Visintin and Pittino, 2014, Diánez-González and Camelo-Ordaz, 2016), it may fail to take account of the mix of orientations among individuals (notably academics). The process of self-categorization on which our identity-based subgroups relied is brief and draws on stereotypes rather than any finer-grained delineation of social identity. As a direction for future research, it seems worthwhile to look more specifically at the social identities of each individual within each subgroup. In this regard, Nikiforou et al. (2018) suggested that the scale developed by Sieger et al. (2016) could be used to capture the social identities of ASO team members.

Secondly, although we assessed faultline strength, we did not test for its possible moderation through cognitive distance optimizers (Knockaert et al., 2011) such as academic entrepreneurs who are more oriented towards commercialization (Marion et al., 2012). Our data did not support such analysis, but this seems another interesting path for future research, as moderate (i.e. weaker) faultlines have been shown to impact positively on performance (Thatcher and Patel, 2012). Our focus on a single country (Italy) is another limitation, although this can also be viewed as a positive factor in helping to control for national institutional setting and regulatory environment (Fini et al., 2011, Ramaciotti and Rizzo, 2015). Other avenues of particular interest for future research relate to method and level of analysis. There have been calls for qualitative research and multi-level analysis in relation to ASOs (Djokovic and Souitaris, 2008), and indeed, qualitative methods would enable a closer analysis of the mechanisms underlying faultlines and cognitive distance optimizers. It would also be interesting to explore links with other levels of analysis, especially macro level outcomes. Overall, the present study illuminates the microfoundations of ASO success and advances the analysis of entrepreneurial team performance.

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Tables

Table 1. Descriptive statistics

Variable	average	SD
Dependent variables		
commercial performance	1.17	2.51
innovation	1.96	4.96
Explanatory and moderator variables		
academics-only team	24%	
presence of non-academics	76%	
presence of academics	95%	
power of non-academics	26%	27%
non-academics as controlling shareholders	16%	
Control variables		
entrepreneurial team size	5.17	3.21
firm size	208431.85	346651.38
venture capital financing	9%	

Average and standard deviation (SD) are shown for continuous variables, along with frequency for dummy variables.

Table 2. Testing H1(a)

	[1] innovation			[2] innovation		
Variable	coef.	SE		coef.	SE	
intercept	-23.64	1.63	***	-9.08	2.09	***
academics-only ET	1.20	0.35	***	1.19	0.40	***
ET size	0.08	0.05		0.05	0.07	
firm size (log)	0.45	0.14	***	0.57	0.16	***
VC financing	-0.11	0.40		0.23	0.46	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	789.26			933.84		

Poisson regression models. Spin-off age was used as an offset variable. Inference was based on sandwich (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.

Table 3. Testing H1(b)

	[3] commercial perf.			[4] commercial perf.		
Variable	coef.	SE		coef.	SE	
intercept	5.90	2.88	**	6.81	3.16	**
academics-only ET	-1.10	0.39	***	-1.08	0.39	***
ET size	0.03	0.07		0.03	0.06	
firm size (log)	-0.52	0.26	**	-0.48	0.26	*
VC financing	1.24	1.27		1.01	1.26	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	625.56			612.98		

Linear regression models. Inference is based on Huber-White (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.

Table 4. Testing H2(a)

	[5] innovation			[6] innovation		
Variable	coef.	SE		coef.	SE	
intercept	-22.44	2.09	***	-7.89	1.96	***
presence of non-academics	-1.20	0.35	***	-1.19	0.40	***
ET size	0.08	0.05		0.05	0.07	
firm size (log)	0.45	0.14	***	0.57	0.16	***
VC financing	-0.11	0.40		0.23	0.46	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	789.26			933.84		

Poisson regression models. Spin-off age is used as an offset variable. Inference is based on sandwich (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.

Table 5. Testing H2(b)

	[7] commercial perf.			[8] commercial perf.		
Variable	coef.	SE		coef.	SE	
Intercept	4.80	2.82	*	5.73	3.09	*
presence of non-academics	1.10	0.39	***	1.08	0.39	***
ET size	0.03	0.07		0.03	0.06	
firm size (log)	-0.52	0.26	**	-0.48	0.26	*
VC financing	1.24	1.27		1.01	1.26	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	625.56			612.98		

Linear regression models. Inference is based on Huber-White (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.

Table 6. Testing H3

	[9] innovation			[10] innovation		
Variable	coef.	SE		coef.	SE	
intercept	-49.32	3.62	***	-34.06	2.46	***
presence of academics	27.76	1.70	***	26.36	1.21	***
power of non-academics	0.28	0.03	***	0.27	0.02	***
presence of acad. x power of non-acad.	-0.29	0.02	***	-0.27	0.02	***
ET size	0.04	0.06		0.01	0.08	
firm size (log)	0.36	0.16	**	0.52	0.16	***
VC financing	-0.07	0.58		0.34	0.57	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	844.99			995.14		

Poisson regression models. Spin-off age is used as an offset variable. Inference is based on sandwich (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.

Table 7. Testing H4.

Variable	[11] commercial perf. coef.	SE		[12] commercial perf. coef.	SE	
intercept	6.07	3.02	**	6.53	3.28	**
non-academics controlling shareholders	-0.64	0.36	*	-0.69	0.38	*
ET size	0.07	0.06		0.06	0.06	
firm size (log)	-0.51	0.27	*	-0.48	0.27	*
VC financing	0.89	1.33		0.64	1.33	
industry fixed effects	Yes			No		
year of foundation fixed effects	Yes			No		
AIC	628.59			615.65		

Linear regression models. Inference is based on Huber-White (robust) standard errors (SEs). ***, **, * denote significance at the 1/5/10% levels, respectively.