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Mapping the engagement of alumni organisations in entrepreneurship education and support at UK universities

This is the final peer-reviewed author's accepted manuscript (postprint) of the following publication:

*Published Version:*

Alessandro Baroncelli, D.B. (2022). Mapping the engagement of alumni organisations in entrepreneurship education and support at UK universities. *INTERNATIONAL JOURNAL OF MANAGEMENT EDUCATION*, 20(2), 1-13 [10.1016/j.ijme.2022.100648].

*Availability:*

This version is available at: <https://hdl.handle.net/11585/908205> since: 2022-11-28

*Published:*

DOI: <http://doi.org/10.1016/j.ijme.2022.100648>

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This is the final peer-reviewed accepted manuscript of:

**Baroncelli, A., Bolzani, D., & Landoni, M. (2022). Mapping the engagement of alumni organisations in entrepreneurship education and support at UK universities. *The International Journal of Management Education*, 20(2), 100648.**

The final published version is available online at:

<https://doi.org/10.1016/j.ijme.2022.100648>

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**Mapping the engagement of alumni organisations  
in entrepreneurship education and support at UK universities**

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## **Abstract**

Alumni have a growing role in supporting entrepreneurship education in universities, but there is scant evidence about their actual engagement with these initiatives. We explored the alumni organisations affiliated to the 162 higher education institutions in the UK to provide insights into their activities in academic entrepreneurship and to explore whether the prevalence of their engagement with these activities is linked to parental higher education institution (HEI) characteristics and regional characteristics. Alumni organisations help their members to access networks of their peers to generate career, mentoring and role-modelling opportunities. Only around 18% of alumni organisations engage in activities to foster entrepreneurship by providing awards and funding and organising networked communities and events. In addition, alumni can also be involved individually in entrepreneurship clubs. Entrepreneurship support activities are more prevalent in alumni organisations affiliated to larger, more resource-rich HEIs that have developed a culture of entrepreneurship and technology transfer. Regional contexts are not relevant for alumni organisations engaging or not in providing entrepreneurship support activities. We discuss future research opportunities to investigate the antecedents, processes and outcomes of engaging alumni organisations in academic entrepreneurship and the policy implications for universities investing in peer support to build their entrepreneurial ecosystems.

**Keywords:** alumni; alumni organisations; entrepreneurship clubs; entrepreneurship education; academic entrepreneurship; entrepreneurial universities.

## **Highlights:**

- We explore the activities carried out by alumni organizations to support entrepreneurship at their parent universities;
- We study the prevalence of alumni engagement into entrepreneurship support as linked to university or regional characteristics;
- We study 169 alumni organizations affiliated to the 162 higher education institutions in the UK in 2017;
- Around 18% of alumni organizations sustain entrepreneurship through awards and funding, networked communities and events;
- Entrepreneurship support by alumni organizations is stronger in larger, resource-richer and commercially-focused HEIs.

## **Introduction**

Alumni organisations are societies dedicated to former students – ‘alumni’ – who maintain linkages with the university where they have been educated. These organisations, although structured in several forms, have the general aim of providing members with opportunities deriving from accessing and maintaining a network with peers and their alma mater, while at the same time allowing them to support their university. The benefits of membership of alumni organisations relate to networking and social events, not only for personal leisure but also for career and business development (Singer and Hughey, 2002).

Scholars and policymakers have called attention to alumni organisations as growingly important institutions for entrepreneurial universities (e.g., Carter and Collison, 1999; Pittaway *et al.*, 2015; EU-OECD, 2012). The activation of collaborative networks of alumni has been suggested as fundamental for universities, not only to support enrolment management (e.g., Claggett and Kerr, 1993) or fundraising (e.g., Okunade, 1993) but also to rethink academic entrepreneurship (Siegel and Wright, 2015) and to foster technology transfer (Scillitoe, 2013) and entrepreneurial education (e.g., Pittaway *et al.*, 2010). Unlike technology transfer offices and other university-supporting instruments, alumni organisations offer different and non-replicable factors that can foster entrepreneurship, such as contacts with entrepreneurs, sharing of experience with peers and role models (Zozimo *et al.*, 2017) and a greater dissemination of hands-on entrepreneurial practices. This renewed attention on alumni is based on the universities’ need to develop priorities through bottom-up initiatives (Carayannis and Campbell, 2012), producing knowledge through interactions with civil society (Sarpong *et al.*, 2017), engaging with external stakeholders in the construction of entrepreneurship education (Matlay, 2009) and contributing to and participating with quality entrepreneurial ecosystems (Isenberg, 2010; Wright *et al.*, 2017).

At the same time, both policymakers and scholars recognise that institutional contexts are conducive to entrepreneurial activity, thus propose the idea that a holistic and evolutionary understanding of entrepreneurial ecosystems is key in the support of high-growth entrepreneurship (e.g., Acs *et al.*, 2014; Audretsch, 2014; Stam and Spigel, 2016). Studies have shown that the presence of knowledge resources, such as universities and incumbent firms, and the exchange of knowledge within a region are conducive to the generation of entrepreneurial opportunities (e.g., Audretsch and Lehmann, 2005). Building on these insights, the activities carried out by alumni organisations in the domain of entrepreneurship education and support should be seen as being influenced by wider university contexts, such as higher education

institutions (HEIs) of different scale, scope, research quality, history and culture, location and networks (Wright *et al.*, 2017).

Despite the relevance of this topic, to date there is a lack of systematic research about the extent of engagement of alumni organisations in sustaining the development of entrepreneurship education and business start-ups in different academic and institutional environments. Therefore, this paper explores: (1) the initiatives and activities carried out by alumni organisations to enhance and support entrepreneurship at their parent universities; and (2) the linkage between university and regional characteristics and the prevalence of activities to support entrepreneurship by alumni organisations.

This study draws on a unique explorative data collection on the population of alumni organisations affiliated to all 162 universities in the United Kingdom to deliver a descriptive analysis of the activities carried out by these organisations in the domain of entrepreneurship. Building on these insights and the limitations of such an explorative analysis, future research opportunities are discussed with regard to antecedents, processes and outcomes of engaging alumni organisations in academic entrepreneurship at different levels of analysis.

The structure of this paper is as follows: First, it presents a literature review of prior research on alumni organisations and a discussion about their role in sustaining entrepreneurship in university environments. It then presents the empirical design of the study and evidence regarding the benefits and services offered to their members by alumni organisations and the forms of support that alumni offer to their associations and their universities, highlighting the specific activities related to entrepreneurship. Finally, findings are discussed and conclusions drawn by suggesting several areas for future research on this topic.

## **1. Literature Review**

### ***2.1 Existing literature on alumni organisations***

Alumni organisations have grown increasingly important for HEIs, leading for instance to universities devoting increasing attention and resources to create dedicated structures to maintain relationships with alumni and to collect alumni survey data. Available literature dealing with university alumni covers a variety of topics, starting with descriptive accounts of alumni associations and their social activities, such as reunions, trips, or other events (e.g., Konzag and Teague, 2009). Some studies have investigated how alumni can serve to evaluate the impact of programmes to support students during their studies (e.g., study-abroad

programmes, Collins *et al.*, 2017; scholarships, Pressey, 1967; curricular programmes, Chen *et al.*, 2012; soft-skills development training, Papadopoulos, 2010) or concerning teaching methods (e.g., Bailey *et al.*, 1997; Dalton, 2018). Another large stream of research has looked at alumni careers and the impact of education on them, for instance on their attitudes towards their learned subjects (e.g., Davis *et al.*, 2000) and career trajectories (e.g., van Dierendonck and van der Gaast, 2013). An important line of research has approached the relationship between alumni and their parent universities from a marketing point of view, studying the perceived image of universities by their alumni and connecting it to brand management and loyalty (e.g., Palmer *et al.*, 2016), and looking at the determinants, modes and consequences of alumni donations (e.g., Monks, 2003). The literature has finally investigated the interaction of alumni with the missions of their universities, such as research (e.g., Jocher, 1945; Vernon *et al.*, 2018) and teaching missions [e.g., curriculum development (Davis and Henshaw, 1974) and mentoring programmes (Gannon and Mahler, 2012)], and third mission related to technology transfer and the commercialisation of science (e.g., Berggren, 2017). This paper specifically speaks to this last stream of research by documenting the activities carried out by alumni organisations to foster entrepreneurship at parent HEIs.

## ***2.2 Entrepreneurial universities' collaborations with external stakeholders***

Universities, together with companies and research laboratories, represent the most important knowledge sources at the regional level, offering both technical and production-oriented factors such as research and development or market intelligence, and 'softer' human-capital-related elements through teaching, research and technology transfer (e.g., Florax and Folmer 1992).

The recent decades have testified to an evolution in the activities carried out by universities to commercialise science and implement technology transfer, moving from a perspective aimed at generating direct financial returns for HEIs to one aimed at providing wider social and economic benefits to the university ecosystem (Siegel and Wright, 2015). This has been practically manifested by the introduction of research performance indicators linked to the economic and societal 'impact' of universities (e.g., the Research Excellence Framework in the United Kingdom). This has shifted attention and practice away from a strong research-third mission nexus, which focuses on top-down supporting practices for academic spin-offs (e.g., Baroncelli and Landoni, 2017; Rasmussen *et al.*, 2014), university–industry research collaborations (e.g., Perkman *et al.*, 2013) and patenting and licensing (e.g., Powers and McDougall, 2005) to a teaching/education-third mission nexus informed by research (Siegel

and Wright, 2015), which emphasises entrepreneurship education (Nabi *et al.*, 2016; Bolzani *et al.*, 2021), experiential competence development (e.g., Bolzani and Luppi, 2021), entrepreneurship centres (e.g., Maas and Jones, 2017), interactions with the civil society and bottom-up initiatives (e.g., Carayannis and Campbell, 2012; Sarpong *et al.*, 2017).

Within this change of perspective, scholars and policymakers have recognised that collaboration with external stakeholders such as alumni is key in fostering academic entrepreneurship (e.g., Matlay, 2009; Siegel and Wright, 2015; Wright *et al.*, 2017) because alumni can ‘bring important skills to academic institutions; they bring an external viewpoint as well as skills and abilities which are not available internally’ (EU-OECD, 2015: 7). However, to date very limited literature has provided specific evidence about the role of alumni and their organisations in shaping and promoting entrepreneurship at their parent HEIs. Rather, a close stream of studies has investigated student-led initiatives or extra-curricular activities for entrepreneurship education. These studies have underlined the role of experiential learning that accrues to current university students through the engagement with student entrepreneurs, for instance by participating in short-term intensive programmes, residential-based programmes, collaborative projects with enterprises and entrepreneurship clubs (e.g., Edwards and Muir, 2006; Matlay and Carey, 2007; Pittaway *et al.*, 2010; Pittaway *et al.*, 2015). In addition, these studies point to the key role of network ties in accessing educational opportunities in the domain of entrepreneurship, given the wide availability of formal, non-formal and informal programmes (Lockett *et al.*, 2017).

### ***2.3 Alumni organisations and embeddedness in university and regional contexts***

Based on the above discussed insights, the engagement of university alumni seems potentially to be valuable in promoting entrepreneurship education and supporting graduate start-ups. It can be reasoned that alumni organisations could be relevant in this regard because they provide a common engagement framework for their members and unique access to a sparse network across alumni. The networked environment of alumni organisations can offer several opportunities for social capital transactions (cf. Adler and Kwon, 2002), which are particularly important in the domain of entrepreneurship. Firstly, alumni represent a strong connection to industry that can be drawn upon by university initiatives and structures to sustain academic entrepreneurship (Berggren, 2017, Rasmussen and Wright, 2015; Siegel and Wright, 2015), especially through programmes to connect entrepreneurs/managers with students (Gordon *et al.*, 2012; Lockett *et al.*, 2017). Therefore, not only can students and potential entrepreneurs



benefit from the technological and human capital spillovers made available by the university in the region (e.g., Florax and Folmer, 1992), but they can also profit from ‘being near’ to alumni, who have shared a common personal and academic track in the same university and are now inserted in the external research or industry ecosystem. Alumni organisations could thus be an opportunity for leveraging alliances (formal and informal) with those who have entrepreneurial knowhow and are keen to share their experiences. Second, various studies argue that people embedded in networks containing entrepreneurs tend to be more entrepreneurially oriented and have a better chance of becoming entrepreneurs themselves (e.g., Davidsson and Honig, 2003; De Clercq and Arenius, 2006). It can be expected that alumni organisations populated by entrepreneurs can prove to be sources of learning opportunities in the domain of entrepreneurship for both alumni and university students (Pittaway *et al.*, 2010), for instance in the provision of advice, mentorship and finance (e.g., Bosma *et al.*, 2004; Casson and Della Giusta, 2007) because entrepreneurial learning is centred on the extent of available social capital (Anderson *et al.*, 2007; Arranz *et al.*, 2018).

Given these considerations, it becomes relevant to know to what extent alumni organisations connected to HEIs offer and organise initiatives and activities aimed at the promotion of entrepreneurship education and business start-ups, not only for their members but for the entire university. At the same time, previous research has underlined that the development of entrepreneurship competences and start-up creations by students or recent alumni are also influenced by the university context and the characteristics of the region within which the university is located (e.g., Bergman *et al.*, 2016). Therefore, it should be expected that the engagement of alumni organisations in entrepreneurship education and support will vary according to the different objectives and strategies of their parent universities relating to academic entrepreneurship, which can be affected by the scale, scope and area of specialisation (e.g., ranking, presence of medical or engineering faculties), resources (e.g., funds, staff), and historical trajectory or culture (e.g., age, research/teaching focus) (Grimaldi *et al.*, 2011; Wright *et al.*, 2017) of their HEIs. In addition, the external environment where universities and alumni organisations are located is a source of support for entrepreneurship, for instance via policies, services and structures to sustain innovation, start-up creation and growth and economic prosperity (e.g., Bergmann *et al.*, 2016; Wright *et al.*, 2017).

## **2. Empirical Design**

### ***3.1 Mapping alumni organisations and their activities***

There is currently no systematic data available regarding alumni organisations and their involvement in entrepreneurship education and support in universities. For this study, an ad-hoc data collection from secondary sources was carried out to explore the research question. As a meaningful context of research on this topic, the study focuses on the United Kingdom, where the government has promoted in recent decades the commercialisation and flow of science through entrepreneurial commercialisation of science and innovation, resulting in the creation and expansion of entrepreneurship teaching and support throughout the country (Hannon, 2007; Rae *et al.*, 2012). In addition, the 2014 Research Excellence Framework (REF) introduced the inclusion of the economic and societal ‘impact’ of research as a performance indicator and evaluation criterion, which has strongly influenced how researchers think about and conduct research (Watermeier, 2016). Impact is defined as ‘an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia’ which ‘includes, but is not limited to, an effect on, change or benefit to a range of contexts’ (REF, 2012, p. 48). In this context, therefore, the assessment of an HEI’s contribution to industry and the local and national economy may have impacted the development and recognition of entrepreneurship education and support, also carried out through engaging alumni organisations, as an important measure of a university’s contribution.

The data collection was carried out in December 2017. As a starting point for the analysis, a manual search was carried out on the internet (using Google and Mozilla explorer tools) to look for alumni organisations formed at each HEI in the United Kingdom, using the list of 162 HEIs provided for the academic year 2015/16 by the Higher Education Statistics Agency (HESA). To search for such organisations, several queries were formed by combining two sets of keywords: (1) ‘alumni’, ‘graduate students’, or ‘graduates’; and (2) the name of the HEI. For each alumni organisation, relevant data were searched concerning the society/group, its activities, the benefits offered to member alumni and the possible ways by which alumni might contribute. In order to maintain a homogenous criterion of analysis across all HEIs in the population, the analyses focused only on the alumni organisations established at the central university level, rather than for each school (i.e., excluding alumni organisations of, e.g., business or medical schools or of single educational programmes, given that entrepreneurship programmes might be offered across a variety of university contexts (e.g., Lourenço *et al.*, 2013; Rae *et al.*, 2012).

As a second step of analysis, an additional search was carried out with regard to the specific activities carried out by alumni organisations to foster entrepreneurship at their HEIs,

through combining three sets of keywords: (1) ‘alumni’, ‘graduate students’, or ‘graduates’; (2) ‘entrepreneur\*’; and (3) the name of the HEI. This second step of analysis focused specifically on the activities carried out by alumni to support enterprise start-up and growth in their HEI, thus excluding institutional programmes managed by HEIs targeting alumni would-be entrepreneurs (e.g., institutional incubation or advice programmes or inspirational events targeting students to meet alumni entrepreneurs), programmes based on national-level public or private schemes to support graduate entrepreneurs (e.g., the British Council Alumni Award, Santander Universities, or Enactus)<sup>1</sup>, and initiatives carried out by student unions to promote entrepreneurship by students through the involvement of alumni. Each activity carried out by an alumni organisation was coded as a dummy variable, being 0 if not present or 1 if present (see Table 1).

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*Insert Table 1 about here*  
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It should be underlined that the empirical design of this paper follows an exploratory strategy having four limitations: (1) examining a single country; (2) not including alumni organisations that might originate at HEI school/department level; (3) being cross-sectional; and (4) using secondary data retrieved from alumni organisations’ websites. As we discuss further in the Conclusions section, it can be anticipated that our results cannot be immediately generalised to larger populations or other countries and do not provide any evolutionary understanding or any causal linkages across variables. The data used are nevertheless reliable because they are retrieved from alumni organisations’ websites, which serve the ‘public’ function of highlighting the activities of these organisations to different interested audiences. Indeed, as many of these websites are managed by parent HEIs, the information can be assumed to be accurate and updated.

### ***3.2 University and regional characteristics***

To answer the second research question about the linkage between university characteristics and the prevalence of activities to support entrepreneurship by alumni organisations, data

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<sup>1</sup>The British Council Alumni Award offers an Entrepreneurial Award for alumni starting growth oriented business ideas (<https://study-uk.britishcouncil.org/alumni-awards>); Santander Universities (<https://www.santander.co.uk/uk/santander-universities/entrepreneurship-business>) funds awards, internships, and start-up creation; Enactus is a program aimed at allowing students to work in team to develop a social enterprise project (<http://enactusuk.org/>).

regarding the key characteristics of HEIs included in the study and the regions where they were located were collected. In line with the variables identified as relevant in the literature review, the HEI-level dimensions that were considered as influencing the engagement of alumni in entrepreneurship education and support were the following: university prestige as measured by the Times Higher Education (THE) ranking; university research and commercial orientation, measured as the income from collaborative research, contract research or consultancy or the presence of a hospital; university entrepreneurial culture, measured as the number of academic spin-offs; university engagement with the external community, measured as the number of attendees at free and paid public events; age, measured as the year of establishment; and resources, measured as staff and student numbers. These data were collected by drawing from datasets of HESA, the European Tertiary Education Register (ETER), and THE.

In line with the variables identified in the literature review, the regional-level factors that were considered as influencing the engagement of alumni in entrepreneurship education and support were the following: regional innovativeness (measured as R&D share of GDP, employment in high-tech manufacturing) and regional economic prosperity (measured as household income). These data were located from OECD regional statistics. Table 1 summarises all measures.

### ***3.3 Data analysis***

In line with the explorative aim of this work, quantitative descriptive analyses were carried out to examine the diffusion and characterisation of an alumni organisation as a tool in entrepreneurship education and support at the parent HEI. To analyse how university contingencies and local context specificities influence the degree of engagement in entrepreneurship activities by alumni organisations, two sets of exploratory analyses were performed: (1) frequency and percentage cross-tabulations, which are useful in assessing whether and how two variables covary (Knoke and Bohrnstedt, 1994), accompanied by chi-square tests of statistical significance; and (2) comparison of means through *t*-tests.

## **3. Results**

### ***4.1 A picture of UK alumni organisations: services and support to/by alumni***

The findings show that 169 alumni organisations are formed by alumni in 161 HEIs in the UK. One university has no alumni organisation, whereas eight universities have more than one. The vast majority of organisations (92.9%) are formed and managed through the impulse of their

parent HEI, and therefore are found on campus and advertised in the university institutional website. While most organisations (96.4%) allow membership to previous students, a very small fraction includes also students, staff or other supporters such as parents or friends. Membership is free of charge in the quasi-totality of cases (95.3%).

Analysing the services offered to members, 91.7% of alumni organisations provide a community for their members, often facilitated by dedicated online platforms or social media and offering social events. This has the goal of allowing members to establish and maintain a network of contacts with peers and their alma mater. Around 75.7% of organisations (s.d. 42.9) offer services of support in professional development and career advancement (e.g., development of soft skills, mentoring, writing of CVs, paid job placement and advice on self-employment and entrepreneurship). In addition, some alumni organisations are able to offer opportunities to work at the HEI itself (19.5%, s.d. 39.8). Around 62.7% of alumni organisations (s.d. 48.5) offer the opportunity to access campus services (e.g., library, e-journals, fitness clubs), either for free or at a discounted rate. Many organisations (56.8%, s.d. 49.7) also offer discounted rates for further education or training (e.g., 10–25% discounts on intensive or post-secondary courses). Some alumni organisations offer their members discounts for entertainment and shopping (44.9%, s.d. 49.9) or for travel, often linked to educational purposes (e.g., flights, hotels) (21.3%, s.d. 41.1). A graphic summary of the services offered to members of alumni organisations is shown in Figure 1.

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*Insert Figure 1 about here*  
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There are several ways in which members can contribute to the activities of their alumni organisation. The findings showed that the most important form of contribution asked of alumni is financial support to sustain their alma mater in carrying out its institutional activities, either in form of donations (81.6%, s.d. 38.8) or fundraising activities aimed at sustaining specific projects or scholarships (24.9%, s.d. 43.3). A second way for alumni to contribute is to participate as speakers at conferences and events to share work and life experiences with students and HEI staff (68%, s.d. 46.7). Third, alumni's experience is valued in supporting current students' career development, through mentoring (52%, s.d. 50.1), job offers (28.9%, s.d. 45.5) or internship offers (42.6%, s.d. 49.6). A final way for alumni to contribute to their HEI is to serve as ambassadors to give information to potential and new students, often abroad (28.9%, s.d. 45.5). These forms of active support open to alumni suggest that HEIs see them

as willing to ‘give back’ through forms of altruistic involvement, which represent the most advanced stage in the alumni relationship-building cycle (Gallo, 2012). Our study, however, is not able to ascertain empirically whether these options of contributing to their university are effectively acted upon by alumni. A graphic overview of the possible contributions offered by members of alumni organisations is shown in Figure 2.

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*Insert Figure 2 about here*  
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#### **4.2 Alumni organisation and entrepreneurship education and support**

In this section, the collected data are analysed to answer the research questions of this paper. First, the study aimed at mapping the engagement of alumni organisations in activities to support entrepreneurship at their HEIs. The data reveal that only 30 out of 169 alumni organisations in the UK (17.7%) show explicitly in their websites that they carry out some specific activities in this regard. According to the findings, six types of activity can be identified, which are non-mutually exclusive for the investigated HEIs: (1) awards and prizes for alumni entrepreneurs (13%); (2) construction of a visible community highlighting alumni profiles and histories to serve as role models (50%); (3) establishment of entrepreneurship-related interest groups, associations or societies, involving either alumni only or other external stakeholders<sup>2</sup> (30%); (4) funding and crowdfunding initiatives sponsored by alumni (10%); (5) support and finance to initiatives and structures of the parent HEIs to foster entrepreneurship (e.g., a Knowledge Transfer Office, a Business School or incubator and their initiatives; 13%); and (6) organisation of events, seminars, lectures, and dissemination of entrepreneurship training materials (10%). For some key examples, see Table A1 in Online Supplementary Materials.

In addition to the activities carried out as part of an organisation, alumni can be involved individually in ‘entrepreneurship clubs’ or ‘entrepreneurship societies’ with the mission to ‘educate, inspire and encourage entrepreneurial interest and ... the development of enterprising skills’ (Pittaway *et al.*, 2010: 39). Through the data collection, 12 entrepreneurship clubs related to eight HEIs could be found across the UK. In contrast to alumni organisations,

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<sup>2</sup> For an example of an ‘entrepreneurial alumni’ association, see: <https://www.arts.ac.uk/alumni-and-friends/alumni-groups/enterprising-alumni-association>; for an example of a larger initiative involving alumni and other stakeholders, see <http://oxfordentrepreneurs.co.uk/>.

entrepreneurship clubs involve a variety of members, such as students, HEI staff, entrepreneurs, investors and people from the local community with an interest in entrepreneurship or business. They engage in several activities, such as organising networking events, experience-sharing, mentoring and one-to-one business development advice, company tours and start-up showcases, talks and lectures by entrepreneurs, competitions and offers of working spaces or fundraising support.

Second, this section explores how the prevalence of activities by alumni organisations to support entrepreneurship is linked to university and regional context specificities. The analysis shows that the majority of alumni organisations supporting entrepreneurship are found in HEIs that are ranked as less prestigious by THE (i.e., outside the top 100 or top 200 HEIs in the world; Tables 2 and 3;  $p < 0.05$ ). This result might seem surprising because prior literature suggested that the more prestigious universities are more able to offer an environment conducive to entrepreneurship. Therefore, this finding could be suggestive that in less prestigious universities alumni organisations act as a strong complement to, or potentially even as substitute for, internally-deployed structures and initiatives promoting entrepreneurship.

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*Insert Tables 2 and 3 about here*  
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With respect to other factors discussed in previous literature as relevant in influencing the different objectives and strategies of HEIs related to academic entrepreneurship, our results show that alumni organisations in medicine-related HEIs are significantly less active in carrying out activities promoting entrepreneurship, as proxied by those institutions having a hospital (Table 4). Scholars have suggested that universities with medical faculties might be able to generate different types of academic entrepreneurship than those HEIs focused on arts, humanities or social sciences (e.g., Wright *et al.*, 2017). Our findings show that alumni organisations in medicine-related HEIs are less active than in other universities, which might be explained in two ways: First, academic entrepreneurship in medical schools might be fostered through the development of internal university structures aimed at sustaining technology transfer, collaboration with industry and research-based entrepreneurship (e.g., Trippel *et al.*, 2015). Second, students in medicine-related universities might become interested in entrepreneurship only if their universities have specific programmes to foster this, since the choice of medicine as a profession might be led by different motivations (e.g., achieving better income and favourable status in society, serving humanity; Ozdemir *et al.*, 2019). Therefore,

alumni organisations in medicine-related universities might be more populated by public servants or managers rather than entrepreneurs, thus being less supportive towards activities in the domain of entrepreneurship education.

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*Insert Table 4 about here*  
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Indeed, the presence of a university-level ‘culture’ of entrepreneurship and commercialisation of research results (e.g., Grimaldi *et al.*, 2011) seems particularly linked to the engagement of alumni organisations in entrepreneurship education and support. In fact, the findings show that these activities are more prevalent in HEIs that perform better in terms of funds raised through collaborative research and consultancy and having higher numbers of academic spin-offs (Table 5).

Lastly, the results confirm the importance of resources available at the university level (e.g., Wright *et al.*, 2017) because alumni organisations actively supporting entrepreneurship are found at larger HEIs (as measured by the number of academic staff) and those with larger international student populations (Table 5).

Our analyses do not find any significant difference in the key characteristics of the regional contexts in which alumni organisations are embedded, whether engaged or not in providing support to entrepreneurship at their parent organisations (Table 5).

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*Insert Table 5 about here*  
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The correlation table among alumni organisation-, HEI- and regional-level variables can be found in Table A1 in the Appendix.

#### **4. Discussion and Conclusions**

Alumni organisations have grown increasingly important for universities and are nowadays a fundamental part of the university entrepreneurial ecosystems (Siegel and Wright, 2015; Wright *et al.*, 2017). However, very limited literature has provided evidence about the practical activities that alumni organisations carry out in shaping and promoting entrepreneurship at their parent HEIs.

This study sheds light on this topic by providing empirical evidence in the UK context. The quasi-totality of HEIs in the UK counts on at least one formal alumni organisation. Most



of these organisations foresee free membership and aim at establishing a community for alumni, offering them the opportunity to attend social events and benefit from networking activities. Alumni organisations offer benefits such as career support and professional development, advantages in obtaining further training and education and access to campus facilities and services. The aim of keeping former students involved with university life is to produce a revenue stream (e.g., donations, scholarships and fundraising), but also to generate career opportunities for current students (e.g., mentoring, job offers), inspiration and role-modelling.

With regard to activities in the domain of entrepreneurship, this research shows that only around 18% of alumni organisations in the UK advertise publicly the presence of activities in this domain. The majority of alumni organisations have a preference to advertise the opportunities to construct a visible community of alumni, highlighting their profiles and histories to serve as role models, or creating entrepreneurship-related interest groups, associations or societies. These results therefore confirm the key role of networking and the creation of social capital and connections between alumni and other members of the academic community (e.g., Wright *et al.*, 2017). Other activities carried out by alumni organisations, although advertised in a lower number of websites, are regarding the organisation of awards and prizes for alumni entrepreneurs and events (e.g., seminars, lectures). Alumni organisations also provide some forms of support through funding and crowdfunding initiatives, either organised autonomously or aimed at sustaining the initiatives and structures of parent HEIs to foster entrepreneurship. In addition, alumni can take part individually in entrepreneurship clubs, which are however not common in the UK, being associated with less than the 5% of the HEI population. However, some of the ‘leading universities have particularly vibrant’ clubs (Pittaway *et al.*, 2010: 39), as in the cases of Oxford and Cambridge.

The results confirm that the engagement of alumni organisations in entrepreneurship activities is a phenomenon related to university-level characteristics of the parent institution. In fact, entrepreneurship support activities are more prevalent for alumni organisations affiliated to larger and more resource-rich HEIs, those having higher numbers of academic spin-offs and those with higher internationalisation rates in the student population. At the same time, alumni organisations are active in the support of entrepreneurship, not only at the most prestigious HEIs in the country, but are less active in medicine-related universities. These findings are suggestive that, although a strong research mission is key in sustaining academic entrepreneurship (e.g., Grimaldi *et al.*, 2011; Wright *et al.*, 2017), the relationships developed

within alumni organisations might be better seen as complements of, or substitutes for, other activities developed internally by universities.

Our findings do not show that alumni organisations that are more active in the support of entrepreneurship are located in more innovative or wealthy regions. However, other characteristics of the regional context that we have not considered in this study could be important and should be further explored to understand better the relationship between embeddedness in different regional contexts and alumni organisations' support for entrepreneurial activities at their parent universities.

We acknowledge that some of the methodological choices in terms of data collection might limit the findings of this study in terms of providing a full picture of the engagement of alumni in entrepreneurship education and support. First, the data were collected from public websites of alumni organisations and parent universities. Therefore, future research could provide more accurate insights by expanding the range of secondary sources or by using primary data collection methods (e.g., surveys or interviews focusing, for instance, on a narrower sample of institutions). Second, the data referred to alumni organisations at the university level and not at the school/department level. This might be an issue since, in several HEIs, entrepreneurship education and the development of such networks is seen first within business schools or based on the inputs of the faculty at the department level (Matlay, 2005; Wright *et al.*, 2017) and is only later taken up at the broader university level. In addition, alumni organisations developed within business schools might benefit from the legitimacy conferred by different international accreditation systems (e.g., ad-hoc rankings and certifications) and access to more business-specific networks than the ones offered at the wider university level. Therefore, future studies should employ more fine-grained sources of data to identify better whether and how different alumni organisations, located in different parts of the university entrepreneurship ecosystem, engage in entrepreneurship education and support. Lastly, this study focused on a single country – the United Kingdom – which represents an interesting context of research but does not allow findings to be generalised to other countries. More research is therefore needed, moving beyond this explorative research, to look at the antecedents, processes and outcomes of the engagement of alumni organisations in entrepreneurship support activities across a wider number of countries.

Despite the above-reported limitations, we believe that this study is important for the literature on academic entrepreneurship and entrepreneurship education because alumni organisations are nowadays present in many universities worldwide, and their contribution in

fostering and supporting academic entrepreneurship is seen as relevant (Siegel and Wright, 2015; Wright *et al.*, 2017). The study provides much needed systematic empirical insights on this phenomenon (EU-OECD, 2012; Pittaway *et al.*, 2010). The findings show that alumni organisations can create several initiatives for their HEIs to disseminate an entrepreneurial mindset, facilitate business relationships and raise financial capital to support start-ups and entrepreneurship education. These voluntary organisations exemplify the opportunities offered by a good match between entrepreneurial enthusiasm, with complementary entrepreneurial and managerial skills, and business relationships, which are key in fostering successful business creation.

The most common activity carried out by the alumni organisations investigated was that of construing communities and societies focused on entrepreneurship-related interests. Because a key focus of alumni organisations is to enable members to connect and share opportunities, future studies should investigate such a relational system generated within universities, concentrating at several directions that reflect the components of entrepreneurship networks: content, governance and structure (Hoang and Antoncic, 2003).

With respect to the content of networked relationships, future studies could, for instance, analyse what resources are effectively brought to the university through social networks established with alumni organisations and entrepreneurship clubs, how these resources can be valuable in helping universities to achieve their goals, and how knowledge transfer from alumni to other actors in universities (e.g., student, researchers, professors, administrative staff) takes place. In this regard, future studies should pay attention to distinguish between university-wide alumni organisations and those having a specific disciplinary nature (e.g., those of business schools) to understand whether social networks developed around common interests in management and entrepreneurship contents are pivotal in ensuring alumni's long-term engagement and commitment to their alma mater. More understanding is also needed with regard to whether and how alumni organisations can favour entrepreneurial learning by channelling and sharing entrepreneurial practices and deploying the human and social capital accumulated by alumni. Another line for future inquiry could examine the individual dynamics of social networking within alumni organisations, the construction of privileged access by alumni to a system of interpersonal relationships, and their impact on the development of academic entrepreneurship.

With regard to governance, future research should disentangle the distinctive mechanisms that characterise networking with alumni in entrepreneurial universities (e.g., trust

among members of the network, power relations between parent HEIs and alumni organisations). Future research should also aim at comparing the antecedents, processes and outcomes on entrepreneurship education of different models of alumni engagement (e.g., alumni organisations vs. entrepreneurship clubs) and of other bottom-up initiatives (e.g., student-led initiatives). Scholars should understand whether these initiatives lead to a convergence of entrepreneurial initiatives within HEIs and whether they are complementary to, or substitutes for, each other and other existing support initiatives.

With regard to network structure, how do the differential network positionings of alumni organisations (e.g., centralisation vs. decentralisation) impact resource flows, and hence, the third mission outcomes of parent HEIs? In addition, while our study highlighted ‘local’ initiatives carried out by alumni organisations, HEIs and policymakers elsewhere have set up policies to support international initiatives involving alumni organisations<sup>3</sup>. Alumni organisations can therefore provide an interesting context in which to examine the impact of proximal or distal network structures connecting actors dispersed in environments external to the universities; for instance, in helping to develop relationships with science and to give access to information about emerging technologies that can be commercialised (e.g., De Carolis *et al.*, 2009).

The findings of this research demonstrate that the engagement of alumni organisations in entrepreneurship education and support is influenced by the university context. It should therefore be acknowledged that alumni, as providers of potential extensions to industry networks (e.g., Matlay, 2009; Rasmussen and Wright, 2015), can become active players in regulating the nature and quality of academic entrepreneurial ecosystems (e.g., Wright *et al.*, 2017). Future studies should investigate the processes and implications of the embeddedness of alumni organisations in their social and institutional contexts. For example, because the social context affects entrepreneurial learning by the observation of role models (Zozimo *et al.*, 2017), future studies should take into account not only how the specific entrepreneurial ecosystems may influence the antecedents, processes, size and outcomes of the entrepreneurial support offered by alumni organisations in different countries but also the ways alumni

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<sup>3</sup> For instance, the European Commission’s Education, Audiovisual and Culture Executive Agency (EACEA) has funded the TEMPUS Entrepreneur Alumni NETwork (EANET). The project is focused on creating a working international entrepreneurial ecosystem of alumni entrepreneurs and young founders, so that students, graduates and academic staff are able to get in contact with companies and the entrepreneurial world.

organisations eventually influence the cognitive institutional environment, moulding beliefs and behaviours about academic knowledge transfer.

From a practical and policy point of view, the findings of this study show that only a minority of HEI-level alumni organisations in the United Kingdom clearly signal and advertise their activities to sustain entrepreneurship. This finding should be taken into account when designing policy measures to support or reward entrepreneurial universities. The positive influence of both internal infrastructure support and external support for university entrepreneurship is worth being taken into consideration if sound development of the university third mission is desired. While more formal support by means of providing infrastructure helps to speed up entrepreneurial formation, peer support by means of engagement by alumni is also a crucial factor in spreading an entrepreneurial ethos within universities. Therefore, the top management of universities and policymakers could consider how better to promote academic entrepreneurship with the support of alumni experience and relationships, for instance by explicitly rewarding those universities offering assistance to new entrepreneurs through alumni organisations within competitive financing programmes.

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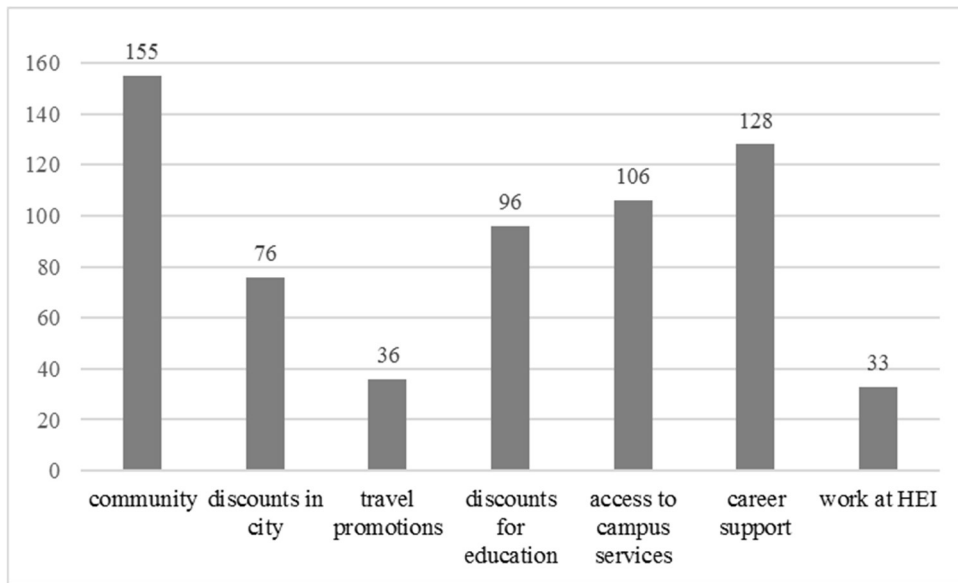


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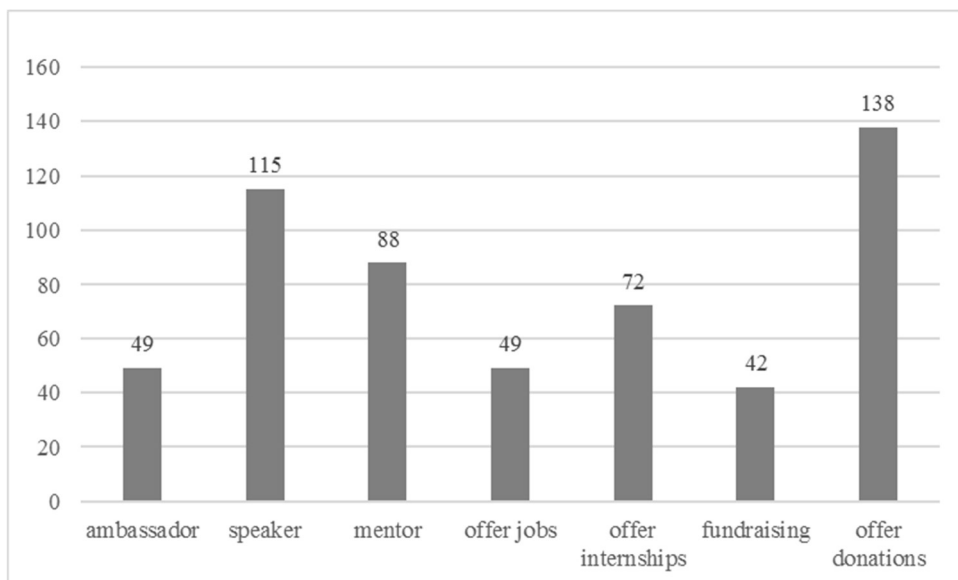
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## FIGURES AND TABLES



**Figure 1 – Number of alumni organisations offering different services to their members**



**Figure 2 – Number of alumni organisations receiving different types of support from their members**

**Table 1 – Measures**

<b>Variable</b>	<b>Description</b>	<b>Source</b>
<b>Alumni organisation-level</b>		
<b>Community</b>	Dummy variable that takes a value of 1 for alumni organisations developing a network of alumni, allowing exchange of experience and social events, 0 otherwise.	Manual search on internet
<b>Shopping discounts</b>	Dummy variable that takes a value of 1 for alumni organisations offering discounts to their members for entertainment, cultural attractions, shopping; 0 otherwise.	Manual search on internet
<b>Travel promotion</b>	Dummy variable that takes a value of 1 for alumni organisations offering promotional prices to their members for travel, in particular for educational travel; 0 otherwise.	Manual search on internet
<b>Discounts for education</b>	Dummy variable that takes a value of 1 for alumni organisations offering discounts to their members for additional training or education at the parent HEI; 0 otherwise.	Manual search on internet
<b>Access to campus services</b>	Dummy variable that takes a value of 1 for alumni organisations offering to their members free access to campus facilities and services (e.g., library, databases, fitness); 0 otherwise.	Manual search on internet
<b>Career support</b>	Dummy variable that takes a value of 1 for alumni organisations offering to their members support services for professional and career advancement; 0 otherwise.	Manual search on internet
<b>Work at HEI</b>	Dummy variable that takes a value of 1 for alumni organisations offering to their members job placement opportunities at the parent HEI; 0 otherwise.	Manual search on internet
<b>Ambassador</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by carrying out activities as an ambassador of the HEI; 0 otherwise.	Manual search on internet
<b>Speaker</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by carrying out lectures, seminars, or workshops to share their experience; 0 otherwise.	Manual search on internet
<b>Mentor</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by carrying out activities as a mentor for students and other alumni; 0 otherwise.	Manual search on internet
<b>Offers of jobs</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by offering job opportunities to students and alumni; 0 otherwise.	Manual search on internet
<b>Offers of internships</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by offering internship opportunities to students and alumni; 0 otherwise.	Manual search on internet
<b>Fundraising</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by carrying out fundraising campaigns for the HEI; 0 otherwise.	Manual search on internet
<b>Offers of donations</b>	Dummy variable that takes a value of 1 if members of alumni organisations can contribute by giving donations to the HEI; 0 otherwise.	Manual search on internet
<b>Alumni organisation support for entrepreneurship</b>	Dummy variable that takes a value of 1 if alumni organisations directly carry out any activity to support entrepreneurship at their HEI or for their members; 0 otherwise.	Manual search on internet

<b>HEI level</b>		
<b>THE100</b>	Dummy variable that takes a value of 1 for HEIs ranked among the top 100 universities in the world THE Rankings 2016; 0 otherwise	Times Higher Education <sup>4</sup>
<b>THE200</b>	Dummy variable that takes a value of 1 for HEIs ranked among the top 200 universities in the world THE Rankings 2016; 0 otherwise	Times Higher Education
<b>Collaborative research</b>	Income from research related activities – total collaborative research involving public funding by HEI, 2015/16 (£ thousands)	HESA
<b>Contract research</b>	Income from research related activities – total value of contracts for contract research by HEI, 2015/16 (£ thousands)	HESA
<b>Consultancy</b>	Total income from consultancy by HEI, 2015/16 (£ thousands)	HESA
<b>HEI spin-offs</b>	Total number of spin-offs with some HEI ownership, 2015/16	HESA
<b>Free public events</b>	Total number of attendees to free public lectures designed for the external community, 2015/16	HESA
<b>Paid public events</b>	Total number of attendees to chargeable public lectures designed for the external community, 2015/16	HESA
<b>Presence of hospital</b>	Dummy variable that takes a value of 1 for HEIs having a hospital; 0 otherwise	ETER <sup>5</sup>
<b>Year of founding</b>	Year of establishment of HEI	ETER
<b>Academic staff</b>	Total full time equivalent staff	ETER
<b>Students</b>	Total number of students enrolled at the lowest degree delivered, 2013	ETER
<b>Foreign students</b>	Total number of foreign students enrolled at the lowest degree delivered, 2013	ETER
<b>Regional level</b>		
<b>Regional R&amp;D</b>	Share of R&D Total Expenditure (in % of GDP), year 2013, large regions (NUTS2)	OECD <sup>6</sup>
<b>Regional innovations</b>	Share of employment in high-technology manufacturing (in % of total employment), year 2013, large regions (NUTS2)	OECD
<b>Regional household income</b>	Disposable household income, USD per head, constant prices, constant PPP, year 2013 (base year 2010), large regions (NUTS2)	OECD

<sup>4</sup> <https://www.timeshighereducation.com/>

<sup>5</sup> <https://www.eter-project.com/>

<sup>6</sup> <https://stats.oecd.org/>

**Table 2 – Bivariate cross-tabulation between alumni organisation support for entrepreneurship (activities present or not) and prestige of HEI (Top-100 THE university or not; percentages in parentheses.)**

Alumni organisation support for entrepreneurship	THE100 ranking		Total
	0	1	
0	132 (85.2%) (95.0%)	7 (50.0%) (5.0%)	139 (82.2%) (100.0%)
1	23 (14.8%) (76.7%)	7 (50.0%) (23.3%)	30 (17.8%) (100.0%)
Total	155 (100.0%) (91.7%)	14 (100.0%) (8.3%)	169 (100.0%) (100.0%)

Pearson chi2 = 10.8728, Pr=0.001

**Table 3 – Bivariate cross-tabulation between alumni organisation support for entrepreneurship (activities present or not) and prestige of HEI (Top-200 THE university or not; percentages in parentheses.)**

Alumni organisation support for entrepreneurship	THE200 ranking		Total
	0	1	
0	115 (86.5%) (82.7%)	24 (66.7%) (17.3%)	139 (82.3%) (100.0%)
1	18 (13.5%) (60.0%)	12 (33.3%) (40.0%)	30 (17.8%) (100.0%)
Total	133 (100.0%) (78.7%)	36 (100.0%) (21.3%)	169 (100.0%) (100.0%)

Pearson chi2 = 7.6070, Pr = 0.006

**Table 4 – Bivariate cross-tabulation between alumni organisation support for entrepreneurship (activities present or not) and presence of a hospital in the HEI (percentages in parentheses.)**

Alumni organisation support for entrepreneurship	Hospital		Total
	0	1	
0	109 (87.9%) (78.4%)	30 (66.7%) (21.6%)	139 (82.3%) (100.0%)
1	15 (12.1%) (50.0%)	15 (33.3%) (50.0%)	30 (17.7%) (100.0%)
Total	124 (100.0%) (73.4%)	45 (100.0%) (26.6%)	169 (100.0%) (100.0%)

Pearson chi2 = 10.1989, Pr = 0.001

**Table 5 – Comparative statistics on selected HEI and regional characteristics**

HEI characteristics	Alumni organisation offers no support for entrepreneurship			Alumni organisation offers support for entrepreneurship			Difference (a)
	N.	Mean	SD	N.	Mean	SD	
Collaborative research	139	7164.46	14,361.09	30	14,383.70	20,949.98	-7219.84*
Contract research	139	6253.41	14,165.57	30	16,927.33	34,824.3	-10,673.92
Consultancy	139	2500.83	4571.25	30	5112.57	6245.35	-2611.73**
HEI spin-offs	139	0.63	1.21	30	2.33	4.59	-1.70*
Free public events	139	40,258.94	191,815.3	30	17,651.07	26,145.46	22,607.87
Paid public events	139	1344.55	3039.82	30	2752.9	5760.88	-1408.35
Year of foundation	136	1881.49	106.33	30	1861.1	201.3	20.39
Academic staff	136	897.54	905.87	30	1544.17	1568.23	-646.63**
Students	129	1556.71	2795.83	28	1762.14	2105.04	-205.43
Foreign students	128	216.36	313.71	28	346.25	368.98	-129.88*
<b>Regional characteristics</b>							
Regional R&D	136	1.59	0.61	30	1.73	0.88	-0.14
Regional innovation	136	0.95	0.29	30	0.98	0.33	-0.03
Regional household income	136	21,483.54	3681.40	30	22,575.13	3899.04	-1091.59

(a) \* p < 0.10, \*\*p < 0.05, \*\*\* p < 0.01. Tests assumed unequal variances across groups.



## APPENDIX (ONLINE SUPPLEMENTARY MATERIALS)

**Table A1 – Examples of activities by alumni organisations to sustain entrepreneurship**

For examples of incubation or advice programmes advertised on alumni webpages, see:
<ul style="list-style-type: none"><li>- <a href="https://www.birmingham.ac.uk/alumni/benefits/entrepreneurs.aspx">https://www.birmingham.ac.uk/alumni/benefits/entrepreneurs.aspx</a></li><li>- <a href="https://www.city.ac.uk/cityventures">https://www.city.ac.uk/cityventures</a></li><li>- <a href="http://www.gsmd.ac.uk/youth_adult_learning/guildhall_creative_entrepreneurs/">http://www.gsmd.ac.uk/youth_adult_learning/guildhall_creative_entrepreneurs/</a></li><li>- <a href="http://www.lboro.ac.uk/alumni/your-career/entrepreneur/">http://www.lboro.ac.uk/alumni/your-career/entrepreneur/</a></li></ul>
For examples of inspirational events targeting students to meet alumni entrepreneurs, see:
<ul style="list-style-type: none"><li>- <a href="http://www.lancaster.ac.uk/alumni/news/archive/features/alumni-voices---start-up-stories/">http://www.lancaster.ac.uk/alumni/news/archive/features/alumni-voices---start-up-stories/</a></li><li>- <a href="https://www.linkedin.com/pulse/university-hull-alumni-entrepreneurs-inspiring-others-paula">https://www.linkedin.com/pulse/university-hull-alumni-entrepreneurs-inspiring-others-paula</a></li></ul>
For examples of initiatives to promote entrepreneurship through the involvement of alumni, see:
<ul style="list-style-type: none"><li>- <a href="https://www.su.rhul.ac.uk/activities/society/Entrepreneurs/">https://www.su.rhul.ac.uk/activities/society/Entrepreneurs/</a></li><li>- <a href="https://www.soas.ac.uk/studententerprise/soas-ventures/">https://www.soas.ac.uk/studententerprise/soas-ventures/</a></li><li>- <a href="https://www.su.nottingham.ac.uk/societies/society/entrepreneurs/">https://www.su.nottingham.ac.uk/societies/society/entrepreneurs/</a></li><li>- <a href="https://www.manchesterentrepreneurs.co.uk/">https://www.manchesterentrepreneurs.co.uk/</a></li></ul>
Source websites:
<ul style="list-style-type: none"><li>- European Tertiary Education Register (ETER) <a href="https://www.eter-project.com/">https://www.eter-project.com/</a></li><li>- Times Higher Education (THE) <a href="https://www.timeshighereducation.com/">https://www.timeshighereducation.com/</a></li><li>- OECD statistics <a href="https://stats.oecd.org/">https://stats.oecd.org/</a></li></ul>

**Table A1 – Correlation table**

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Alumni organisation support to entrepreneurs	1.000																
2 Collaborative research	0.1740*	1.000															
3 Contract research	0.2069*	0.5825*	1.000														
4 Consultancy	0.2006*	0.5858*	0.3681*	1.000													
5 Graduate spin-offs	-0.0317	0.0074	-0.0049	-0.0294	1.000												
6 HEI spin-offs	0.2840*	0.4492*	0.7252*	0.2443*	0.1329	1.000											
7 Free public events	-0.0497	0.2086*	0.0317	0.1724*	-0.0045	0.0750	1.000										
8 Paid public events	0.1463	0.2627*	0.4172*	0.1918*	0.0153	0.4523*	0.1015	1.000									
9 THE100 ranking	0.2536*	0.5448*	0.6685*	0.4463*	-0.0464	0.4969*	0.0164	0.3631*	1.000								
10 THE200 ranking	0.2122*	0.6006*	0.6071*	0.5134*	-0.0350	0.3126*	0.1052	0.3298*	0.5780*	1.000							
11 Year of HEI founding	-0.0614	-0.4869*	-0.4773*	-0.3158*	0.0430	-0.5104*	0.0028	-0.4147*	-0.4894*	-0.3978*	1.000						
12 Hospital in HEI	0.2457*	0.6532*	0.5263*	0.4927*	0.0271	0.3166*	0.0680	0.2292*	0.4023*	0.5702*	-0.3397*	1.000					
13 Academic staff	0.2311*	0.8118*	0.8032*	0.5916*	0.0284	0.5991*	0.1545*	0.4592*	0.6980*	0.7204*	-0.5503*	0.6279*	1.000				
14 Students	0.0294	-0.0636	0.0149	-0.0300	0.0235	0.0508	-0.0238	0.2863*	-0.0313	-0.1108	0.0615	-0.0426	0.1758*	1.000			
15 Foreign students	0.1530	0.0211	0.0956	0.0075	0.0185	0.1071	-0.0502	0.1723*	0.0243	0.0298	0.0022	0.0764	0.2194*	0.6420*	1.000		
16 Regional R&D	0.0816	0.1107	0.0427	0.1805*	-0.0196	0.0652	0.0501	0.2113*	0.0536	0.0530	-0.1818*	0.1192	0.1471	0.1063	0.0056	1.000	
17 Regional innovation	0.0346	0.0445	0.0549	0.1037	-0.0453	0.0588	0.0600	0.2428*	0.0075	0.0153	-0.1065	-0.0073	0.1334	0.2042*	0.0456	0.7677*	1.000
18 Regional household income	0.1128	-0.0917	0.0384	-0.0227	0.0413	0.0570	-0.0860	0.0409	0.0680	-0.0754	-0.0119	-0.0951	-0.0575	-0.0181	0.2182*	-0.1220	-0.0654

\* p < 0.05