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Item Type	Article
Authors	Abreu, M.;Grinevich, Vadim
Citation	Abreu M and Grinevich V (2024) Intrapreneurial ecosystems in academia and their overlooked outputs: Graduate employability and wellbeing. Technovation. 133: 102996.
DOI	<a href="https://doi.org/10.1016/j.technovation.2024.102996">https://doi.org/10.1016/j.technovation.2024.102996</a>
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Download date	2025-08-22 19:46:02
Link to Item	<a href="http://hdl.handle.net/10454/19955">http://hdl.handle.net/10454/19955</a>



# Intrapreneurial ecosystems in academia and their overlooked outputs: Graduate employability and wellbeing

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## ARTICLE INFO

### Keywords:

Academic intrapreneurship  
Intrapreneurial ecosystem  
Graduate employability  
Graduate entrepreneurship  
Graduate wellbeing

## ABSTRACT

The aim of this paper is dual: a) to elaborate a systemic concept of intrapreneurship in academia which will be reflective of complexities and idiosyncrasies of the University as a multi-mission multi-function organisation; and b) to empirically test this concept in the context of relatively neglected outputs of academic intrapreneurship such as graduate employability and graduate wellbeing. Guided by an intrapreneurial ecosystem framework, our analysis is based on a combination of administrative and survey panel data for 141 UK higher education institutions. We arrive at several contributing findings. These suggest that the intrapreneurial ecosystem within academia is increasingly predisposed towards enhancing the quality of graduate outcomes rather than simply promoting raw measures such as graduate jobs or the number of graduate start-ups. Furthermore, we reveal the critical role of University national stakeholder networks for graduate career satisfaction, start-up generation, and undergraduate employment. Finally, our empirical exercise and its results demonstrate the practical value of the proposed concept of the intrapreneurial ecosystem for University management and practitioners, not least because it systematically identifies areas for an immediate, medium- and long-term action.

## 1. Introduction

There is renewed interest in intrapreneurship as a way of responding to ongoing challenges faced by the University, including budget constraints, increased competition, and policy pressures to demonstrate the relevance of university education and research for the economy and wider society (Blanka, 2019). As a concept, academic intrapreneurship was introduced in the late 1980s (Perlman et al., 1988) but it was some time before it received sufficient traction in the academic literature. The concept has its roots in the wider intrapreneurship research field, where intrapreneurship is understood as entrepreneurship within an existing organisation. It can manifest in a variety of innovative activities and orientations including new ventures, new products and services, new strategies, and new management techniques, and can benefit any part or function of the organisation (Antoncic and Hisrich, 2003). In contrast, the academic intrapreneurship literature has been slower to acknowledge the variety of forms and applications that intrapreneurship can take within academia. Most studies equate academic intrapreneurship to technology transfer and commercialisation activities (Bicknell et al., 2010; Burkholder and Hulsink, 2022). Adopting a broader perspective where other missions of the University (e.g., education and research) are

also considered as an arena for intrapreneurial activities remains an exception (Guerrero et al., 2021; Rossano-Rivero, 2019). Yet, today's University is a complex multi-mission, multi-layer, multi-function and multi-product organisation which is more likely to benefit from designing and implementing a comprehensive and systemic approach towards intrapreneurship. This represents the underlying assumption motivating our study.

The aim of the paper is, therefore, dual: a) to elaborate a strategic and systemic concept of intrapreneurship in academia which will be reflective of complexities and idiosyncrasies of the University; and b) to empirically test this conceptualisation. To achieve (a), we elaborate the notions of the intrapreneurial ecosystem elements and outputs in academia. This represents an extension of the general entrepreneurial ecosystem framework (Stam and van de Ven, 2021), enriched with specific conceptual insights drawn from relevant academic intrapreneurship and entrepreneurial university studies (Guerrero and Urbano, 2012; Perlman et al., 1988; Vogel and Fischler-Strasak, 2014, among others). More specifically, our framework is applied at the level of a given university rather than a particular geographical region. It departs from equating productive entrepreneurship as an output of the intrapreneurial ecosystem solely to activities with direct high-growth

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<https://doi.org/10.1016/j.technovation.2024.102996>

Received 14 April 2023; Received in revised form 29 February 2024; Accepted 12 March 2024

Available online 29 March 2024

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financial returns. To reflect the unique position of the University as an organisation with multiple deliverables that directly or indirectly contribute to societal capacity to generate additional output, which is at the core of the notion of the productive entrepreneurship (Baumol, 1993), we propose to consider a broad range of outputs of the University's entrepreneurial ecosystem. These relate to education research, technology transfer, knowledge exchange, enterprise, graduate employability, graduate satisfaction, civic engagement, and institutional reputation. In doing so we assume the presence of intrapreneurial intentions and behaviours of all university staff, both academic and non-academic. In our categorisation of the outputs along the typically debated missions of the University such as research, teaching, and societal impact we propose that very few types of outputs of the intrapreneurial university could be solely attributed to one particular mission. Finally, in relation to the ecosystem elements, we propose, in addition to institutional arrangements and organisational resources, to explicitly identify 'intrapreneurial capabilities'. These represent the organisational ability to entrepreneurially adapt to the internal and external environments and self-renew as an organisation (Klofsten et al., 2021). We, therefore, define intrapreneurship at the University as a process by which academic, managerial, support, and other staff ideate and introduce novelties across teaching, research, knowledge exchange and governance, and ensure organisational renewal and relevance of the University. Correspondingly, the University's intrapreneurial ecosystem is theorised as a set of elements and interdependencies at the level of a given University, organised in a such way that they enable outputs that are deemed meaningful (i.e., adding value) from the organisational point of view.

To achieve (b), we explore intrapreneurial ecosystem configurations influencing graduate employability and graduate wellbeing (e.g., manifested in career path fulfilment, meaningfulness of post-graduation experiences, and satisfaction with the relevance of the skills obtained). Graduate outcomes are rarely explored in the context of academic intrapreneurship. Yet, they are among the core competitiveness metrics influencing the economic and financial sustainability of today's University, shaping its reputation and upholding its autonomy (Compagnucci and Spigarelli, 2020). In this regard, the University as an organisation depends on intrapreneurial actors who identify and act on opportunities to introduce novelties in their area of responsibility, which eventually result in enhanced graduate outcomes, defined in terms of both graduate employability and graduate wellbeing. The University is also becoming increasingly strategic when putting in place structures and processes to enable intrapreneurial activities amongst its staff. These arrangements, however, may not always be balanced to consider all potential outputs of the intrapreneurial ecosystem, often prioritising those with a direct financial return (Siegel and Wright, 2015a). By exploring graduate outcomes from an intrapreneurial ecosystem perspective, our study contributes by revealing both pre-existing biases and emerging shifts in focus in intrapreneurial activities within the University, shaping graduate entrepreneurship, employment, and wellbeing. Importantly, our study and its findings demonstrate the practical value of the proposed concept of the intrapreneurial ecosystem for the University and its management, not least because it systematically identifies areas for an immediate, medium- and long-term action.

The remainder of the paper is organised as follows. The next section discusses the theoretical motivation and elaborates the theoretical framing underlying our inquiry. Section 3 describes a novel combination of institution- and micro-level longitudinal data sources used in this study, and details our methodology. Section 4 discusses our findings, and Section 5 concludes.

## 2. Theoretical background and motivation

### 2.1. Academic intrapreneurship and intrapreneurs

Academic intrapreneurship as a concept and research field is still in

its infancy (Burkholder and Hulsink, 2022; Blanka, 2019). Yet, one of the first attempts to develop the academic intrapreneurship perspective was made more than three decades ago by Perlman et al. (1988) arguing that corporate lessons of success and competition from an intrapreneurial perspective should be adapted by higher education institutions. Defining intrapreneurship as entrepreneurship turned inward and manifested in new ventures within an organisation, Perlman et al. (1988) argue that it allows highly complex and bureaucratic organisations (such as the University) to hold on to their best talent in terms of innovation and creativity. In their view, intrapreneurship is the only way to successfully achieve many strategic goals of the University. This plurality of strategic goals is explained by the University's idiosyncracies and multiple constituencies, complicated governance and decision-making structures, and (frequently) a combination of inflexible administrative rules, collegiality and democracy, and the presence of multiple academic groups and subgroups. Perlman et al. (1988) see intrapreneurship as a process involving academic faculty, university management and academic support services, extending across all core missions of the University (such as education, research and 'meeting society's needs'). The academic intrapreneurship process is presented as an interaction between the institutional environment and an individual intrapreneur. The former comprises the external higher education environment and internal organisational context. The external environment is usually shaped by education and science policy, markets, competition, socio-economic and demographic factors affecting student enrollment, faculty numbers and university budgets, as well as broader changes in technology and societal attitudes pushing the University towards change (Manns and March 1978; Perlman et al., 1988; Clark, 1998; Klofsten et al., 2019). It is argued that the external environment could be volatile, rapidly changing and ambiguous, making a strong case for an intrapreneurial university (Perlman et al., 1988). The extent to which the University could 'intrapreneurially' respond to the changes in the external environment may vary. For instance, Manns and March (1978) observe that academically strong departments are less responsive to adverse external conditions, which may be due to them having innovated before in providing a very attractive offering for students and, therefore, having less room for further innovation compared to academically weaker departments; or it may be due to some internal characteristics of departments that may constrain their responsiveness. In the Perlman et al. (1988) model, the internal academic intrapreneurship context is shaped by internal University processes, structures, technologies that are reflective of institutional norms, culture, values, rituals, leadership, and empowerment of people. Related to this, Meyer and Rowan (1977), in their seminal work on institutionalised organisations, noted that organisational conventions that celebrate institutionalised 'myths' (e.g., a university must have certain departments no matter what, or hire a Nobel Prize winner as a matter of prestige) may differ from organisational structures that are needed to enable innovation and efficiency. Perlman et al. (1988) with their novel perspective and insights on intrapreneurship in academia appeared to be well ahead of their time and not very well understood by their contemporaries (Bogue, 1990). It was not until the early 2000s when we saw a renewed interest in the academic intrapreneurship discourse, reflecting many of Perlman et al. (1988)'s observations and proposals.

Similar to the Perlman et al. (1988)'s argument, Kirby (2006) calls for the University, as a highly complex, bureaucratic, routinised yet idiosyncratic large organisation, to embrace the intrapreneurship model of development as a way to successfully compete and meet the commercial needs of the knowledge-based economy, as well as societal expectations about the relevance of academic research. According to Kirby (2006), central to this model is a culture of enterprise that enables entrepreneurial behaviour to spread across the University, pervade each of its missions, and empower both entrepreneurial academics and students. Focusing at the organisational level strategic actions to imbue academic intrapreneurship, he notes the need for the respective university policies and procedures to be not only clear, fair and well

communicated, but also very specific, in order to address intra-organisational barriers to intrapreneurial behaviour. Such actions could include endorsements and role models at the senior University level, incorporation of enterprise at the departmental, faculty and individual plan levels, 'hard' (e.g., infrastructure and incubators), and 'soft' (e.g., mentoring, training, signposting) support, reward and promotion systems.

The majority of the literature on academic intrapreneurship is concerned with knowledge transfer and commercialisation activities. Some studies directly conceptualise knowledge transfer as academic intrapreneurship (Bicknell et al., 2010), finding that knowledge transfer-active academics clearly distinguish themselves from entrepreneurs elsewhere by prioritising problem-solving within their innovation network (comprised of students, colleagues, and collaborators), and appreciating alternative non-monetary scholarly benefits alongside monetary ones. Similarly, Burkholder and Hulsink (2022) define academic intrapreneurship as the individual behaviours of academics within the University that lead to knowledge commercialisation activities which are distinct from their regular research and education initiatives. They proceed to identify three areas of the University's internal environment that can enhance academic intrapreneurship in the form of knowledge commercialisation. These are the workloads of academics, rewards system for academic intrapreneurs, and availability of internal finance for innovative projects.

Commercialisation of university knowledge and technology transfer are often equated to the so-called third mission of the university (Compagnucci and Spigarelli, 2020). According to Etzkowitz (1998), the university's adoption of this mission in addition to education (the first mission) and research (the second mission) exemplifies a 'second revolution' in academia. Comparing it to the first academic revolution through which research became the second mission, he argued that 'capitalisation of knowledge' and socio-economic development emerged as the new mission of the university, establishing the latter as an economic actor in a knowledge driven economy. The shift towards the 'capitalisation of knowledge' is often viewed as a threat to academic freedoms and the concept of knowledge as a public good (Chubb et al., 2017; Philpott et al., 2011; Slaughter, 2020). Consequently, an increasing body of the literature emphasises that the third mission cannot and should not be restricted to research commercialisation activities, and can be viewed as a voluntary service to society contributing to innovation, community development and societal change (Compagnucci and Spigarelli, 2020), including a variety of commercial and non-commercial forms of knowledge exchange (Abreu and Grinevich, 2013, 2014; Abreu et al., 2016; Klofsten and Jones-Evans, 2000; Vargiu, 2014). Furthermore, a number of studies highlight an insufficient focus in the literature on the inter-influences between education, research, and the third mission of the University (Sengupta and Ray, 2017; Siegel and Wright (2015a; 2015b). While there were concerns that the third mission could divert resources away from basic research and undermine teaching performance, on balance there appears to be limited empirical evidence for any negative effects of the third mission on teaching and research. (Compagnucci and Spigarelli, 2020). It is argued by a range of studies that all three missions can synergise and create added value for each other, making a case for the embedding of the third mission into both education and research (Nelles and Vorley, 2010; Pinheiro et al., 2015).

Similarly, in the context of academic intrapreneurship, considering it only from the point of view of technology transfer and commercialisation cannot fully capture its transversal nature as initially implied by Perlman et al. (1988), and subsequently argued for by a few other studies exploring academic intrapreneurship in alternative contexts. For instance, Rossano-Rivero (2019) develops a discussion on academic intrapreneurship in the context of educational activities. This is based on a premise that academic intrapreneurship is a process by which academics pursue entrepreneurial opportunities for new value creation within the University via new ways of working across different missions

of the university, including teaching. Soncin and Arnaboldi (2022) also choose to focus on novelties in education (such as massive open online courses [MOOCs]) as a context for exploring the academic entrepreneurship concept. Resonating with the prior literature, they find that technical infrastructure, financial resources, empowerment, and operational support are among the critical elements influencing academic intrapreneurship. Using the same MOOCs context, Guerrero et al. (2021) reveal a direct role of MOOC-related intrapreneurial capabilities (e.g., risk tolerance, opportunity sensing, transformative routines) in the achievement of university outcomes related to the learning environment, income, and international outlook; as well as an indirect role mediating the positive effect on the university outcomes of essential institutional capabilities related to research, teaching and administrative support quality.

A broader perspective on academic intrapreneurship as a process by which academics introduce novelties across teaching, research and knowledge exchange activities echoes an integrated view on corporate intrapreneurship as a process of creating new ventures and initiatives within an organisation that leads to organisational renewal (e.g., new strategic direction), organisational rejuvenation (e.g., enhancement of organisational functions and implementation processes), regeneration (e.g., introduction of new services/products) and redefinition (e.g., creation or exploitation of new markets) (Covin and Miles, 1999; Farukh et al., 2019; OECD, 2005; Rossano-Rivero, 2019). Insights into academic intrapreneurship understood as entrepreneurial behaviours of academics and academic groups enabling and resulting in organisational renewal and innovation are very rare (Burkholder and Hulsink, 2022). Among the exceptions is a study by Hagedorn and Jamieson (2014) on intrapreneurial sensemaking as an approach to re-invision the mission of a University School. They emphasise the connection between nurturing an entrepreneurial mindset within the University (e.g., via supportive and participative leadership) and the ability of the University to re-imagine its positioning and direction in an increasingly ambiguous and competitive higher education environment.

To summarise, there has been a renewed interest in the concept of academic intrapreneurship and its implementation. This is largely driven by complex challenges facing the University related to financial constraints, increased competition, and policy pressures to demonstrate the relevance of its research and educational offerings. To succeed and maintain its relevance without compromising its core academic values and ethos, the University is encouraged to learn from the corporate world to activate its intrapreneurial potential and enhance its intrapreneurial capabilities (Klofsten et al., 2019). The academic intrapreneurship literature remains relatively compact. It is skewed towards the technology transfer and knowledge commercialisation activities, to some extent reflecting an accelerated transition towards entrepreneurial university models (Guerrero et al., 2016). Other applications of academic intrapreneurship such as those related to research, education and organisational innovation remain largely under the radar both conceptually and empirically. While the University ('corporate') culture, leadership and support structures appear to be among key factors enabling proactive, creative and risk tolerant behaviour of academics, the role of different configurations of organisational factors in relation to a variety of relevant University outcomes are yet to be consistently understood.

## 2.2. Towards an ecosystem view on intrapreneurship in academia

As discussed in the previous section, we argue that there are multiple gaps in our understanding of intrapreneurship in academia. These can be explained by the high complexity and idiosyncrasy of the University as an organisation which has multiple missions and multiple products and services, delivered by multiple sub-organisations with different rules, norms, and cultures, and populated by autonomous academic employees with sometimes little or no sense of a common goal. In this context, one way to develop a systematic view on the phenomenon is to elaborate an

intrapreneurial ecosystem perspective, in order to capture the core ecosystem elements that can enable the intrapreneurial activities of university employees, leading to the achievement of the diverse University mission outcomes. The existing literature on intrapreneurship in academia has yet to offer such a perspective, reflecting an overall lack of ecosystem theorising within the broader intrapreneurship literature. One of the earlier attempts to theorise corporate intrapreneurship from a systems point of view was made by Russell (1999), proposing that structure and culture represent two organisational subsystems that affect corporate entrepreneurship in two distinct ways. According to Russell, the autonomy, free exchange of information, and control over resources that are associated with a certain organisational structure may support intrapreneurial activities, but do not guarantee a commitment towards innovation, whereas the culture and associated entrepreneurial values and beliefs do make employees operate innovatively. Ferrary (2013) places emphasis on an incentive contract and open innovation structure as two core synergising elements of an intrapreneurial ecosystem. One of the most complete intrapreneurial ecosystem frameworks is proposed by Vogel and Fischler-Strasak (2014). At the heart of it are: culture of innovation (values that all employees can relate to; inclusive idea generation process; tolerance of failure), architecture for innovation (creative workspaces; idea labs; flexible commercialisation arrangements), talent management (education; mobility; customised rewards) and communication and collaboration (to refine/pivot ideas and engage in open innovation with stakeholders and other actors in the external environment comprising government, markets and location).

In relation to intrapreneurship in academia, the model outlined by Perlman et al. (1988) appears to remain the only one which explicitly operates within a construct of academic intrapreneurship, offering insights into the core elements of the academic entrepreneurship environment. This model is largely consistent with those of the broader intrapreneurship ecosystem literature, emphasising culture, structure, people empowerment, and leadership. It is also very instrumental for understanding the complexities of the higher education normative and cultural context which combines bureaucracy, democracy and collegiality across its multiple groups and subgroups with inevitable implications for intrapreneurial processes. Elsewhere in the academic entrepreneurship field, the ecosystem perspective has not been fully leveraged by academic entrepreneurship scholars due to a disproportionate focus on individual ecosystem elements at the expense of strategic ecosystem conceptualisations (Hayter et al., 2018). Also, within this literature, academic entrepreneurship is largely viewed as spinoff generation and commercialisation of intellectual property outputs, which would be a narrow view on the phenomenon (Abreu and Grinevich, 2013), only partially reflecting intrapreneurial outcomes within academia. One of the few exceptions is a conceptualisation of the entrepreneurial university by Guerrero and Urbano (2012). They do not explicitly use the “intrapreneurship” term but list teaching, research, and entrepreneurial activities as outputs of the entrepreneurial university, which is consistent with the intrapreneurial perspective. Their conceptualisation of internal (resources and capabilities) and external (formal and informal) factors also resonates closely with our prior discussion on the intrapreneurial environment operating within a higher education institution.

Against this theoretical backdrop, we further elaborate a concept of the University’s intrapreneurial ecosystem. To be able to strategically embrace specific conceptual insights drawn from academic intrapreneurship, intrapreneurial ecosystems and entrepreneurial university studies, we adapt a systematic framing of an entrepreneurial ecosystem perspective. The term ‘entrepreneurial ecosystem’ was coined by Cohen (2006), building on prior entrepreneurship literature (e.g., Neck et al., 2004; Spilling, 1996; van de Ven, 1993) that called for advancing a systematic view on entrepreneurship, highlighting the role of multiple interconnected actors and elements (including formal and informal networks; academia; government; professional services; capital services; talent; culture and physical infrastructure) in generating new ventures.

Subsequent entrepreneurial ecosystem studies (e.g., Isenberg, 2010; Feld, 2012; Spiegel, 2017; Stam, 2015; Stam and van de Ven, 2021) referred to a similar set of entrepreneurial ecosystem elements covering the domains of policy, culture, supporting actors and markets. Of these, Stam and van de Ven (2021) stood out as one that proposed a model of the entrepreneurial ecosystem where its elements can be conveniently operationalised into variables, i.e. measures of these elements. Defining the entrepreneurial ecosystem as a set of interdependent elements that are organised in such a way that enable ‘productive’ entrepreneurship, Stam and van de Ven (2021) propose to distinguish between two blocks of elements that are essential for sustaining entrepreneurship. These are (i) institutional arrangements and (ii) resource endowments. Within the former, a distinction is made between formal institutions (rules of the game), informal institutions (culture), and the social networks of the actors. The latter (resource endowments) are captured by physical infrastructure, knowledge, financial resources, talent (human capital), leadership, intermediate (producer) services and market demand. This systemic representation of entrepreneurial ecosystem elements is conceptually compatible with prior theorising and exploring of the factors of academic intrapreneurship (Burkholder and Hulsink, 2022; Hagedorn and Jamieson, 2014; Perlman et al., 1988; Kirby, 2006; Soncin and Arnaboldi, 2022) as well as studies on intrapreneurial ecosystems in general (Ferrary, 2013; Russell, 1999; Vogel and Fischler-Strasak, 2014).

Yet, the repurposing of the Stam and van de Ven (2021) model for elaborating and operationalising the concept of academic intrapreneurship ecosystem has to involve a number of specific assumptions and extensions. These are illustrated in Fig. 1 and summarised as follows. Firstly, the academic intrapreneurship ecosystem model is applied at the level of a given University rather than a particular geographical territory as often assumed in the entrepreneurial ecosystem literature. Secondly, the notion of ‘productive entrepreneurship’ normally proxied in the entrepreneurial ecosystem literature by high-growth firms has to be rethought in the context of academic intrapreneurship. As argued above, the University is a complex and idiosyncratic organisation with multiple missions implying a variety of outputs related to technology transfer, enterprise, research, teaching and learning, graduate employability, graduate wellbeing, civic engagement and institutional reputation.<sup>1</sup> Each of these deliverables is a subject for an intrapreneurial opportunity and action by relevant University staff including academics, managers, and professional service staff. Moreover, it can be argued that this inclusive conceptualisation of the outputs of the University’s intrapreneurial ecosystem, which are meaningful from the point of view of both an individual member of the University and the University as an organisation, is closest to the original meaning of ‘productive entrepreneurship’ as an activity that directly or indirectly contributes to the societal capacity to produce additional output (Baumol, 1993). Thirdly, as we adhere to the view of the University as a multifaceted institution with multiple organisational layers, functions and deliverables, we propose that relatively few types of outputs of the intrapreneurial university could be solely attributed to one particular mission of the University. For instance, in relation to the research mission, these would most likely be discoveries and scientific publications underpinned by the quest of knowledge and understanding for its own sake. The scientists

<sup>1</sup> We interpret ‘reputation’ as a composite output of the intrapreneurial ecosystem. Ultimately, different stands of intrapreneurship activities and their outputs (including those related to the quality of education, research, societal impact, etc.) shape the reputation of the University (Compagnucci and Spigarelli, 2020). A seminal study by Manns and March (1978) indicates that a strong reputation of an academic department could imply a high degree of prior innovation. High reputation can be viewed as an important output of intrapreneurial efforts within the University. It increases competitiveness and strengthens university autonomy and bargaining power (Compagnucci and Spigarelli, 2020; Manns and March 1978; Salamzadeh et al., 2016).

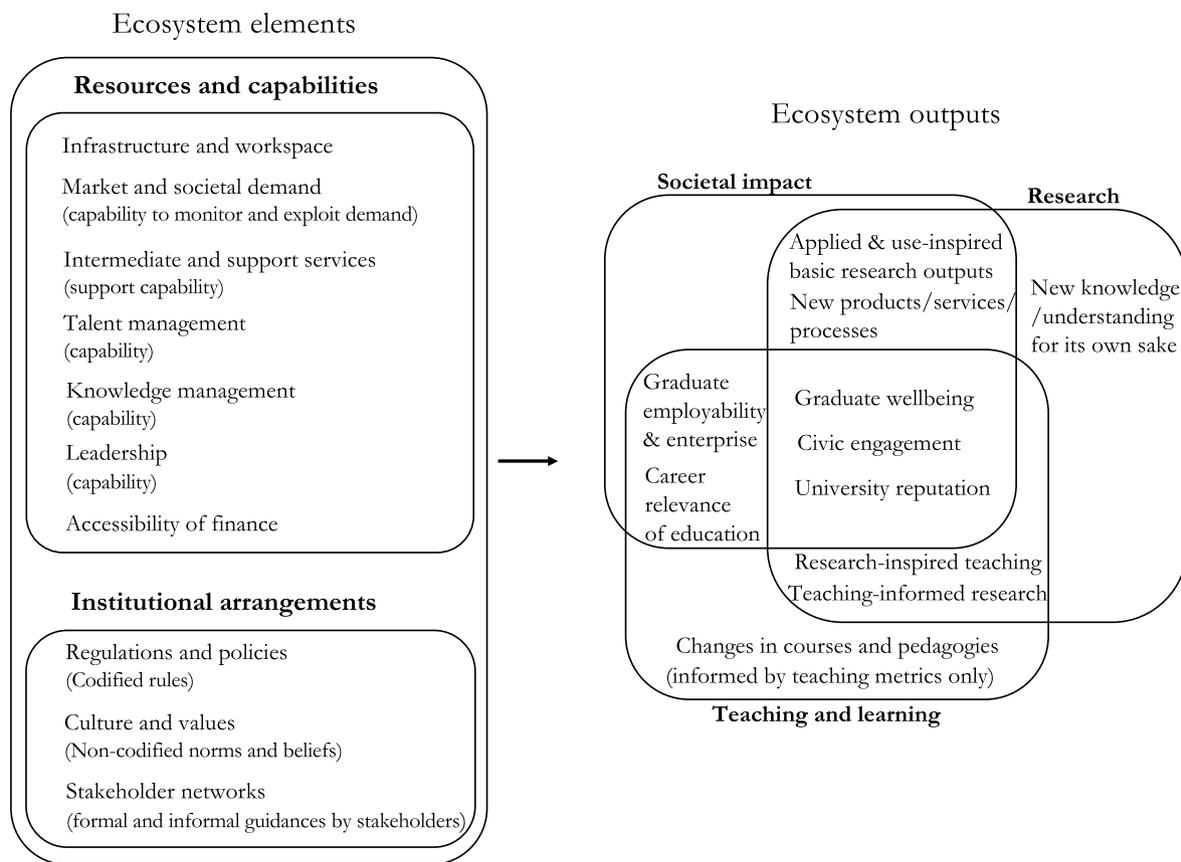


Fig. 1. Intrapreneurial ecosystem at the University: elements and outputs.

and research groups behind this discovery-driven research are likely to demonstrate limited concern for the potential practical applications of their research findings (Stokes, 1997). It is notable, however, that they may still innovatively collaborate with industry not with the aim of pursuing commercialisation activities, but rather to advance their fundamental research (Lam, 2010, 2011). As evidenced by the growing body of literature, research activities conducted in the context of use (e.g., ‘use-driven basic’ and ‘pure applied’ as defined by Stokes [1997]) tend to be more productive in terms of scientific output and show a positive association with socio-economic impact (Tijssen, 2018). This prompts us to categorise the respective scientific outputs (e.g., inventions, new theories, new methods, publications) of the ecosystem at the intersection of research and societal impact missions. The same inter-mission positioning is proposed to apply to the outputs from technology transfer and knowledge exchange that result in new products, services and processes needed and desirable by the economy and society (Compagnucci and Spigarelli, 2020). Similarly, in relation to the teaching mission, the scope of intrapreneurial outputs (e.g., in terms of new modules, new programmes, new pedagogies, etc.) could be very limited if they were ideated and implemented in isolation from the research and societal impact missions. While some changes and enhancements in teaching, learning and assessment can be informed by teaching practice and teaching evaluation metrics only, this approach is rarely recommended by education professionals and should be interpreted as an extreme ideal type (Biggs et al., 2022). Innovation in teaching has long been associated with the nexus between teaching and research missions, manifested by research-inspired teaching and empowered by teaching-inspired research (Campbell, 2013). Teaching activities have also always been linked to the needs of the economy and society, and this link has been strongly emphasised in the discourse on

graduate employability, enterprise, the career relevance of education, and teaching requiring a noticeable community involvement with the aim of widening participation (Boden and Nedeva, 2010; Goddard, 2018; Nghia et al., 2020; Siegel and Wright, 2015a). Furthermore, one can argue that there are several ecosystem outputs that emerge due to novelties introduced at the intersection of teaching, research, and societal impact missions. Among the examples can be outputs related to holistic human development and wellbeing of graduates (Finley, 2016; Posselt, 2021), or civic engagement initiatives and projects integrating civic and community-centred scholarship, education, and university governance (Stanton, 2008; Goddard, 2018). The proposed categorisation of ecosystem outputs along the typical dimensions of academia such as teaching, research, and societal impact implies the transversal nature of the latter. Effectively, the societal impact mission is shown to be embedded within the research and teaching missions, as the societal impact outputs cannot be considered separately from the outputs associated with teaching or research or both (Goddard, 2018; Nelles and Vorley, 2010; Pinheiro et al., 2015). Finally, in relation to the ecosystem elements, in addition to institutional arrangements and organisational resources, we propose to specify University capabilities for leveraging and managing the resources to enable and implement intrapreneurial opportunities within the institution. Conceptually, such capabilities can be defined as ‘intrapreneurial capabilities’ representing the organisational ability to entrepreneurially adapt to internal and external dynamics and self-renew as an organisation (Klofsten et al., 2021). These capabilities can be captured by several elements of the ecosystem, e.g., leadership and management skills, talent and knowledge management, intermediate and support functions. These in turn can help make a better use of resources (including physical and digital infrastructure, finance, and market and societal demand), as well as navigate institutional

arrangements (e.g., codified rules and policies<sup>2</sup>; non-codified norms and cultural beliefs; and guidance emanating from stakeholder networks).

Hence, we approach an intrapreneurial ecosystem in academia as a set of elements and interdependencies at the level of a given University, organised in a such way that they enable intrapreneurial opportunities for all academic and non-academic staff at the University, and ensure an effective exchange of information and other resources between the University and the external environment. This would be for intrapreneurial purposes across a variety of University deliverables that are deemed to add value from the organisational point of view. We view intrapreneurship at the University as a means for different academic and professional groups to more efficiently achieve their various objectives, through developing a common innovation-driven culture and shared entrepreneurial identity in an environment characterised by the complexity and fragmentation of tasks, activities, and structures (Clark, 1998; Kirby, 2006; Klofsten et al., 2019). This organisation-centred perspective emphasising specific priorities of a given University and its constituting parts is in contrast, for instance, to the Triple Helix model where every University as an entity is expected to be an economic actor in a knowledge-based economy, regionally and nationally, alongside the industry and government, by focusing on technology transfer and incubating new firms (Etzkowitz and Zhou, 2017). Our conceptualisation of the entrepreneurial ecosystem places the focus of attention on a highly situated nature of intrapreneurial initiatives originating from within the University. This enables us to ‘unhide’ and embed into the model the plurality of the ecosystem outputs that go beyond technology transfer and short-term commercial gains, and which are more representative of diverse goals pursued by the University as an organisation. While the Triple Helix model is sometimes criticised for lack of context and oversimplification of the stakeholder relationships (Cai and Amaral, 2021; Etzkowitz and Zhou, 2017), in our intrapreneurial ecosystem theorising we elevate the role of ‘intrapreneurial capability’ elements that are essential for navigating nuanced interactions across national and regional contexts with various stakeholders following different institutional logics (e.g., large corporations, social enterprises, non-government organisations, local communities, among others). The respective stakeholder influences and power imbalances are carefully captured in the ecosystem framework by the elements capturing institutional arrangements. Understanding these is critical given that the university may be subject to significant pressure by some powerful industry actors in relation to research agendas and core values, leading to a bias towards applied research and the neglect of fundamental and socially oriented research, liberal arts and education. The pressure to generate commercial outcomes can undermine academic freedom and hinder long-term, curiosity-driven research (Chubb et al., 2017; Philpott et al., 2011). By overly focusing on industry partnerships and commercialisation, universities may overlook research that addresses pressing social issues (e.g., climate change) and contributes to the public good (Cantwell and Kauppinen, 2014).<sup>3</sup>

### 2.3. Graduate employability and graduate wellbeing as outputs of the intrapreneurial ecosystem

With the academic intrapreneurship literature dominated by technology transfer and knowledge commercialisation contexts, many other relevant outputs of the academic intrapreneurship ecosystem tend to

<sup>2</sup> Instead of the term ‘formal institutions’, we prefer to use ‘codified rules and policies’ to avoid confusion with contexts where a given institution deemed formal may provide both formal written rules and informal non-written guidance, which may not always be aligned with each other (for further theoretical discussion see Thornton and Ocasio, 1999).

<sup>3</sup> The argument about the risks involved due to commercialisation pressures on the University is directly provided by an anonymous referee in their review, for which we are very grateful.

remain under the radar. In this regard, Siegel and Wright (2015a) observe that a new type of university ecosystem is emerging where the University’s knowledge transfer is expected to make a broader social and economic contribution to society. This contribution goes beyond direct financial returns from academic spin-offs, patents and licensing activities, and encompasses indirect returns related to graduate outcomes. It is argued, for instance, that university education and research can indirectly lead to entrepreneurial activities such graduate start-ups and corporate spin-offs, which are also known to be more successful and associated with more societal benefits than academic spin-outs (Siegel and Wright, 2015a, 2015b). There have been suggestions that Technology Transfer Offices and their staff need to play a proactive role in supporting entrepreneurial skills development and networking among students, and to be fully integrated into the curriculum (Siegel and Wright, 2015a; Wright, 2014).

Becoming an entrepreneur is one of many potential employability outcomes for a university graduate. From the institutional point of view, the university is highly motivated towards its graduates obtaining a skilled job after graduation. Graduate employment is one of the core competitiveness metrics influencing rankings, reputation, and economic and financial sustainability of today’s University (Compagnucci and Spigarelli, 2020). It is, therefore, essential for the University to put in place structures and processes to support creative intrapreneurial approaches and initiatives amongst its staff to enhance the employability prospects of its graduates. Previous academic entrepreneurship studies provide selected insights into the effectiveness of certain ecosystem elements for graduate employability prospects. For instance, Guerrero et al. (2020) find positive effects of university business incubators and entrepreneurship education on graduate self-employment prospects, echoing the evidence on the positive impact of accelerators and entrepreneurial learning on entrepreneurial efforts of students (Breznitz and Zhang, 2019; Metcalf et al., 2021; Morris et al., 2017). Furthermore, Meoli et al. (2020) find that university support mechanisms such as upskilling initiatives for administrative staff are critical for graduates making successful career choices and especially for those contemplating an entrepreneurial career. This implies a link between the training of university staff and their intrapreneurial initiatives, which enhance the employability outcomes of graduates. It is notable, however, that these studies also expose a shortage of systematic evidence from which we could draw both theoretical and practical insights into the effectiveness of university intrapreneurial ecosystems in enhancing graduate employability.

One can argue, however, that the University provides a wide range of educational opportunities, including liberal arts, humanities, and social sciences, which may not have direct career pathways. While graduate start-up and employment rates are important, they may not fully capture the value of these disciplines, may not reflect the broader impact of education on personal growth, critical thinking, and societal contributions; may not fully reflect the role of the University in providing educational access, social mobility, and addressing social equity; and may not capture the long-term success and satisfaction of graduates. Graduates contribute to society in various ways, including through volunteering, community leadership, and participation in democratic processes. Hence, graduate employability should be viewed as part of a broader range of graduate outcomes that include the holistic development of graduates, graduate satisfaction, career path fulfilment, meaningfulness of post-graduation achievements and the relevance of the skills obtained. Combined, these contribute to graduate wellbeing which can be understood as the quality of life of an individual after completing their education. Graduate wellbeing is an important but largely overlooked output of the university’s intrapreneurship ecosystem (Finley, 2016; Marken, 2021; Yorke and Knight, 2006). It is closely related to the role of the University as an institution fostering intellectual growth, critical thinking, and personal development. Universities are expected to focus on nurturing students’ curiosity, creativity, cultural enrichment and empathy, enabling them to become engaged citizens who contribute

**Table 1**

Outputs and elements of the intrapreneurial ecosystem, and corresponding variables used in the empirical analysis. Full variable descriptions are provided in Appendix A.

Ecosystem outputs and elements	Variables included in the analysis
<b>Ecosystem outputs</b>	<p><i>Graduate start-ups</i>: new enterprises, including social enterprises, created by recent graduates (% of cohort).</p> <p><i>Undergraduate employment</i>: undergraduate students who are in full-time employment 15 months after graduation (% of cohort).</p> <p><i>Postgraduate employment</i>: postgraduate students who are in full-time employment 15 months after graduation (% of cohort).</p> <p><i>Activity is meaningful</i>: whether graduates strongly agree with the statement “My current activity is meaningful” 15 months after graduation (% of cohort). Activity includes employment, self-employment or freelancing, developing a creative, artistic, or professional portfolio, volunteering, further study, caring for others, extended travel, and other activities.</p> <p><i>Activity fits career plans</i>: whether graduates strongly agree with the statement “My current activity fits with my future plans” 15 months after graduation (% of cohort).</p> <p><i>Course was useful for activity</i>: whether graduates strongly agree with the statement “I am using what I learnt during my studies in my current activity” 15 months after graduation (% of cohort).</p>
<b>Regulations and policies</b>	<p><i>Business representatives on board</i>: business members on university’s governing board (% of board members).</p> <p><i>Civil society representatives on board</i>: civic society members on university’s governing board (% of board members).</p> <p><i>Public sector representatives on board (%)</i>: public sector members on university’s governing board (% of board members).</p> <p><i>Required contracting system</i>: whether the university has a required contracting system for all staff engagement with external partners (dummy variable).</p>
<b>Culture and values</b>	<i>Entrepreneurship training (start-ups)</i> : whether the university offers start-up support via entrepreneurship training (dummy variable).
<b>Stakeholder networks</b>	<p><i>Benefits from business engagement</i>: benefits to the university from business engagement (scale 1–4).</p> <p><i>Priority: local area</i>: whether engagement with partners in the local area is a university priority (dummy variable).</p> <p><i>Priority: region</i>: whether engagement with partners in the region is a university priority (dummy variable).</p> <p><i>Priority: national</i>: whether engagement with partners at the national level is a university priority (dummy variable).</p> <p><i>Priority: international</i>: whether engagement with partners at the international level is a university priority (dummy variable).</p>
<b>Infrastructure and workspace</b>	<p><i>On-campus incubator (start-ups)</i>: whether the university offers start-up support via an on-campus incubator (dummy variable).</p> <p><i>Off-campus incubator (start-ups)</i>: whether the university offers start-up support via an off-campus incubator (dummy variable).</p> <p><i>Science-park space (start-ups)</i>: whether the university offers start-up support via science park space (dummy variable).</p>
<b>Market and societal demand</b>	<p><i>Business advice (start-ups)</i>: whether the university offers start-up support via business advice (dummy variable).</p> <p><i>Monitoring of labour markets</i>: extent to which university monitors skill needs and sectoral changes (scale 1–5).</p> <p><i>Employer curriculum design</i>: extent to which employers are involved in curriculum design (scale 1–5).</p> <p><i>Exploitation company (owned)</i>: whether the university has a fully-owned exploitation company (dummy variable).</p> <p><i>Exploitation company (majority)</i>: whether the university has a majority-owned exploitation company (dummy variable).</p> <p><i>Exploitation company (minority)</i>: whether the university has a minority-owned exploitation company (dummy variable).</p>
<b>Intermediate and support services</b>	<i>Internal department for engagement</i> : whether the university has a department for external engagement (dummy variable).
<b>Talent management</b>	<p><i>Indemnity insurance for staff</i>: whether the university provides indemnity insurance for staff (dummy variable).</p> <p><i>Staff incentives for engagement</i>: extent of staff incentives to engage with external partners (scale 1–5).</p> <p><i>Staff rewards for IPR</i>: whether staff are rewarded (financially or otherwise) for IPR (dummy variable).</p> <p><i>Student placements (central)</i>: whether graduate placements are arranged centrally (dummy variable).</p> <p><i>Student placements (department)</i>: whether graduate placements are arranged by academic departments (dummy variable).</p> <p><i>Student placements (ad hoc)</i>: whether graduate placements are arranged on an ad-hoc basis (dummy variable).</p>
<b>Knowledge management</b>	<p><i>Files IPR in house</i>: whether the university files IPR in house (dummy variable).</p> <p><i>Requires disclosure of inventions</i>: whether the university requires staff to disclose inventions (dummy variable).</p>
<b>Leadership</b>	<p><i>Strategic plan (business)</i>: extent of university strategy for engagement with business (scale 1–5).</p> <p><i>Strategic plan (public and civic)</i>: extent of university strategy for engagement with public and civic sectors (scale 1–5).</p> <p><i>VC pay (in £100k)</i>: total annual remuneration for the university’s head of institution (in £100,000s, adjusted for inflation).</p>
<b>Accessibility of finance</b>	<p><i>Seed corn investment (start-ups)</i>: whether the university offers start-up support via seed finance (dummy variable).</p> <p><i>Venture capital (start-ups)</i>: whether the university offers start-up support via venture capital (dummy variable).</p> <p><i>Funds for teaching (equipment)</i>: whether external engagement activities provide funds for teaching equipment (dummy variable).</p>

meaningfully to society. As the world is constantly evolving, and job requirements change rapidly, equipping students with the skills and mindset necessary for lifelong learning is critical. Equally, developing a sense of social awareness and ethical responsibility is essential for building a just and compassionate society. By fostering a love for learning and equipping students with transferable skills, the University can empower individuals to adapt to changing circumstances, acquire new knowledge, and pursue continuous personal and professional development. By exposing students to a wide range of perspectives, ideas, and experiences, universities encourage tolerance, open-mindedness, and a global outlook. This exposure should help students develop a broader understanding of the world and prepare them to thrive in a diverse and interconnected society.<sup>4</sup> In this regard, we know surprisingly little or nothing about the relative importance of the institutional arrangements, resources, and capabilities available to university staff to innovatively pursue opportunities to enhance the value and meaningfulness of higher education programmes, as they relate to the

post-graduate experience. These opportunities are increasingly linked to initiatives enabled by digital technologies such as digital learning via MOOCs, transforming teaching technology and equipping students with relevant digital skills (Guerrero et al., 2021; Macchiarella and Smith, 2021; Soncin and Arnaboldi, 2022). More research is undoubtedly needed to examine the wellbeing dimensions of the student experience linked to digitally enabled learning, and the related post-graduate wellbeing outcomes (Perna et al., 2014).

### 3. Data and methods

#### 3.1. Data sources

Our analysis seeks to understand graduate employability and wellbeing outcomes, as a function of the intrapreneurial ecosystem that they encounter while at University. We use a number of sources in order to build an institution-level data set for the UK, covering almost all higher education institutions, with the exception of a handful of small, specialised colleges, and one for-profit university, for which some of the administrative data is missing. There are currently 160 institutions in the UK that are entirely devoted to higher education, the vast majority of which are universities providing undergraduate and postgraduate

<sup>4</sup> We are very grateful to one of our anonymous referees for suggesting this argument in the context of the University’s role in fostering intellectual growth, critical thinking, and personal development.

teaching in a range of subjects, and which are almost exclusively private charitable institutions.

All of the data sources used in this study are collected and compiled by the Higher Education Statistics Agency (HESA), an independent agency that produces official statistics relating to higher education on behalf of UK government departments and agencies (including the Office for Students, Department for Education, and the Department for Business, Energy, and Industrial Strategy), and higher education providers. HESA collects and processes a wide range of data, including administrative data on university finances, staff, capital investments, and student enrolment, information on institutional priorities and activities across the teaching, research, civic, and knowledge-exchange missions, and detailed data on student and graduate outcomes, and views, which are collected using large-scale survey instruments. In this paper we restrict our analysis to the period 2017–2020, covering the academic years 2017/18, 2018/19, and 2019/20, for which all of the required data is available, and fully comparable over time. Our dataset is a balanced panel that covers 141 institutions over three years.

Our source of graduate employment and wellbeing data is the Graduate Outcomes survey, which is distributed by HESA, and sent to every undergraduate and postgraduate student in the UK approximately 15 months after graduation.<sup>5</sup> We use three waves of the Graduate Outcomes survey, completed by students who graduated in 2017/18, 2018/19, and 2019/20. The survey is the largest and most detailed of its kind for the UK and has a response rate of 52.3% for UK domiciled full-time graduates, with slightly lower response rates for part-time graduates (48.7%) and for international graduates (46.1% for EU, 29.4% for other countries).<sup>6</sup> The surveys for the 2018/19 and 2019/20 graduands were distributed during the Covid period, so all our regression models include time fixed effects to control for the economy-wide impacts on graduate employment during that time.

Our institution-level data was assembled from a number of databases provided by HESA for the academic years 2017/18, 2019/19, and 2019/20. Our key institutional variables come from the annual Higher Education - Business and Community Interaction (HE-BCI) survey, which covers aims, policies, strategies, and processes surrounding university engagement with external business, civic society, and public sector partners. Part A of the survey, the qualitative component, provides both subjective assessments of the benefits of commercialisation and external engagement (e.g., “Please rank the following partners/clients in terms of benefits ultimately delivered”, “How do you rate the level of incentives for staff to engage with business and the community”), and objective questions (e.g., “Does your institution have any subsidiary companies or distinct departments responsible for business and community interactions, and what are they?”).<sup>7</sup> Part B of the survey provides quantitative administrative data, such as the number of graduate start-ups, the number and value of patents and licences, the number and value of collaborative research contracts, and number of attendees at externally facing events.

<sup>5</sup> The surveys are sent out in quarterly waves based on the month of graduation, with those graduating in June (most common for undergraduate courses) receiving the survey in September–November of the following year, and those graduating in September (most common for taught postgraduate courses) receiving the survey in December–February of the following year. The Graduate Outcomes survey replaced the previous Destinations of Leavers from Higher Education (DLHE) survey, which was distributed around 6 months after graduation. The first Graduate Outcomes survey was completed by students who graduated in 2017/2018.

<sup>6</sup> The Graduate Outcomes survey questionnaire is available here: <http://www.hesa.ac.uk/files/C21071%20Graduate%20Outcomes%20survey%20%28survey%20in%20full%29.pdf>.

<sup>7</sup> The HE-BCI Part A survey questionnaire is available here: [https://www.hesa.ac.uk/collection/c19032/hebcia\\_questions](https://www.hesa.ac.uk/collection/c19032/hebcia_questions). Definitions for the HE-BCI Part B data set are provided here: <https://www.hesa.ac.uk/support/definitions/hebcib>.

In addition to the HE-BCI survey, our analysis also includes one variable from the HESA Finance database, which provides information on university financial accounts. We include the value of the Vice-Chancellor’s annual remuneration package, in £100 k.<sup>8</sup> This variable is included in order to capture value placed by the institution on appointing internationally-renowned (potentially transformative) leadership, which we assume is proxied by the remuneration package.

An overview of the variables included for each of the elements of our intrapreneurial ecosystem is provided in Table 1 (and discussed further in Section 3.3), and detailed descriptions of the variables, including data sources, units, and (where relevant) survey questions, are provided in Appendix A. Descriptive statistics for all the variables are provided in table B1 in Appendix B.

### 3.2. Methods

The aim of our paper is to analyse the intrapreneurial ecosystem determinants of graduate outcomes (broadly defined), and we use six different outcome measures in the analysis. Our first set of outcome measures capture employment outcomes, including graduate entrepreneurship (proxied by graduate start-ups), and the proportion of undergraduate and postgraduate students (respectively) who are in full-time employment within 15 months of graduation. Our second set of measures capture outcomes relating to graduate satisfaction with their current activity, and whether their activity is meaningful, with activity widely defined to include employment, running a business, freelancing, creative and portfolio work, voluntary or unpaid work, further study, travel, unpaid care, and other miscellaneous activities. The intention is to cover graduate wellbeing and the wider purpose of higher education, beyond narrow employability measures. More specifically, our second set of outcomes capture the proportion of graduates who strongly agree with the statements “My current activity is meaningful”, “My current activity fits with my future plans”, and “I am using what I learnt during my studies in my current activity”. The aim of these measures is to shift the focus to the quality of graduate outcomes, as perceived by the graduates themselves.

One important issue, from an empirical point of view, is the likelihood that even a rich dataset could miss important differences across institutions, some of which are likely to be unobservable but also correlated with the variables included in the analysis. As an example, the extent to which a university involves employers in curriculum design (a measure of the “market and societal demand” element of our ecosystem model) could be related to the presence of a well-connected and influential employer in the region, something that is difficult to measure in practice. In addition, changing national economic circumstances are likely to affect most graduates in a specific year, in a way that would not necessarily be captured by the variables included in the analysis. Our solution is to estimate a regression model that controls for any time invariant characteristics of our institutions (e.g., persistently higher levels of employer engagement), in a way that allows us to focus on the effects of changes in our ecosystem variables (e.g., an increase in employer engagement in an institution in a particular year) on subsequent graduate outcomes. Our model also controls for any changes that happen in all institutions in the same year (through year-of-graduation fixed effects).<sup>9</sup>

Our model, for each of our outcome variables, is the following:

$$Y_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \beta_n X_{nit} + \varepsilon_{it}$$

<sup>8</sup> In the UK, the Vice-Chancellor is the most senior University officer, in charge of all academic and administrative affairs, in a role equivalent to that of President in other countries. The Chancellor has a mainly ceremonial role and is not involved in the day-to-day running of the institution.

<sup>9</sup> For reference we also provide the standard OLS regression results, without the two-way fixed effects. These results are shown in Appendix B.

where  $Y_{it}$  is the outcome measure for graduates of institution  $i$  in the academic year  $t$ ,  $\alpha_i$  is the institution fixed effect, capturing any unobservable differences across institutions,  $\alpha_t$  is the year fixed effect, capturing national variations in graduate outcomes that are common to all institutions in a given year of graduation,  $\beta_0$  is a constant, the variables  $X_{1it}$ ,  $X_{2it}$ , etc. Denote the

Explanatory variables of interest (discussed in Section 3.3), which capture the elements of the intrapreneurial ecosystem in institution  $i$  and year  $t$ ,  $\beta_1$ ,  $\beta_2$ , etc. Are the respective coefficients, and  $\varepsilon_{it}$  is a random error term.

### 3.3. From theory to empirics

A key challenge of this paper is to find appropriate measures to fully capture all the elements of the intrapreneurial ecosystem, as shown in Fig. 1, and to do this in a way that is both sufficiently detailed but also consistent across the entirety of the UK higher education sector. As discussed in Section 3.1, the institutional datasets collected by HESA are essentially a census of all higher education institutions in the UK, since all institutions are required to provide the information, which is then used for a variety of policy, research, and governance purposes. In translating our theoretical model into the empirical one shown in Section 3.2, we worked our way through the nine major databases available, and looked for all the variables that were relevant measures of the elements of the ecosystem shown in Fig. 1.<sup>10</sup>

The results of this exercise are shown in Table 1, indicating each element of our theoretical ecosystem, and the corresponding variables available in the data. It is important to note that all the variables listed in the table are determinants of the outcomes in their own right, and they are not interchangeable in respect to our empirical model. In other words, they do not measure the same concept, but rather fall into the same category of variable.

The variables included in the analysis are as follows. Our outcome variables include three graduate employment outcomes: graduate start-ups, employability of undergraduate students, and employability of postgraduate students. We also consider three measures of graduate wellbeing beyond direct employability: graduates who believe their current activity is meaningful, graduates who believe their current activity fits their career plans, and graduates who think the course was useful for their current activity. We use a broad definition of “current activity” that includes paid work for an employer, running a business, freelancing, creative and portfolio work, voluntary or unpaid work, further study, travel, unpaid care, and other miscellaneous activities.

Moving on to the elements of the ecosystem, we first consider the institutional arrangements that support or constrain the intrapreneurial outcomes. Starting with regulations and policies, we include three variables that reflect the composition of the university’s governing board or council (in the form of the proportion of business representatives on the board, as well as civil society representatives, and public sector representatives). These are intended to capture a general institutional orientation towards engaging with the business sector, civil society, and the public sector, respectively. We also include a measure of whether the institution requires its staff to use a formal contracting system for any outward-facing activities. This captures the extent to which the institution has formal or rigid policies for dealing with intrapreneurial activities. Moving on to culture and values, we include a variable that

<sup>10</sup> A second purpose of the exercise was to understand to what extent the available data is sufficient to capture the full extent of the University’s intrapreneurial ecosystem, and identify any key variables that are currently missing from the HESA databases, in order to feed this information into future data collection plans. These findings were presented to HESA as part of a review of their HE Business and Community Interaction (HEBCI) survey in September 2022. For an overview of all the available HESA datasets, see here: <https://www.hesa.ac.uk/data-and-analysis>.

captures whether the institution offers entrepreneurship training to its staff and students. This measure is intended to indicate an institutional culture that supports innovative activities and intrapreneurship.<sup>11</sup> Finally, to capture the extent and nature of institutional stakeholder networks, we include a variable that indicates whether the institution perceives that there are significant benefits from business engagement, and several variables to indicate the geographical extent of the university’s stakeholder priorities (with national networks the reference category in the regression models).

Turning to the resources and capabilities elements of the ecosystem, we capture infrastructure and workspace using a number of variables that indicate whether the institution provides off- or on-campus incubators and science park space for staff and student start-ups. These variables provide an indication of the value the institution places on entrepreneurship and innovation, via its support for the appropriate capital infrastructure.<sup>12</sup> Our next set of variables cover the institution’s knowledge of, and engagement with, its market. We define “market” broadly to include external demand for the institution’s graduates, knowledge, services, civic activities, and cultural outputs. We capture this using a set of variables that include whether the university provides business advice for student and staff start-ups (indicating the extent to which it is aware of the wider market context), two measures of institutional engagement with the graduate job market (whether the university actively monitors labour markets, and whether it involves employers in curriculum design), and three variables to capture whether the university actively participates in the commercialisation of knowledge outputs (indicated by the presence of various types of exploitation company). Along the same lines, we incorporate the intermediate and support services element using variables that capture whether the university has an internal department for engagement with external partners, and whether it offers indemnity insurance for staff, both proxies for active support for innovation and entrepreneurship activities.

Our next set of elements cover different aspects of management and leadership. To capture the talent management element, we include two variables that measure active support and encouragement of the university towards intrapreneurial initiatives (whether the university provides staff incentives for external engagement, and whether it rewards staff for the creation of IPR). We also include several variables to capture how the institution supports student career development beyond teaching and learning activities, indicating how the university arranges student placements with external partners (whether this is done centrally, or more informally by departments or on an ad-hoc basis). To cover the knowledge management element, we include two variables to capture how formal (and potentially inflexible) the institution’s approach to knowledge management is, as proxied by whether the institution files IPR in house, and whether it requires staff to disclose inventions. For the leadership element, we include a number of variables to capture whether the institution has a strategic plan for engagement with business, and for engagement with the public and civic sectors. We also include a measure of the Vice-Chancellor’s pay (in £100 k) to capture the value placed by the institution on attracting highly remunerated leadership, which we treat as a proxy for the value placed on reputation and visibility of leadership.

Our final element is accessibility of finance, and we operationalise this using three variables: the availability of seed corn investment, the availability of venture capital, and the availability of funds for

<sup>11</sup> There is a significant lack of data at the national level (covering all institutions) on this particular element, and this is one of the dimensions that future versions of the HE-BCI survey, and other HESA data collections, could helpfully expand on.

<sup>12</sup> This is another element of the ecosystem that could be captured more thoroughly in the HESA surveys. In particular, digital infrastructure is not captured by any available survey or administrative data instruments, and is of increasing importance in a post-Covid higher education landscape.

Table 2

Two-way fixed effects regressions with robust standard errors, for graduate start-ups and graduate full-time employment 15 months after graduation.

	Graduate start-ups	Undergraduate employment	Postgraduate employment
<b>Regulations and policies</b>			
Business representatives on board (%)	0.018 (0.017)	0.026 (0.037)	-0.029 (0.042)
Civil society representatives on board (%)	-0.012 (0.013)	0.003 (0.039)	-0.008 (0.051)
Public sector representatives on board (%)	0.011 (0.008)	-0.026 (0.025)	0.029 (0.032)
Required contracting system	0.503** (0.201)	-1.863 (1.488)	-0.403 (1.381)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	-0.119 (0.224)	-0.186 (0.694)	1.157 (0.775)
<b>Stakeholder networks</b>			
Benefits from business engagement	-0.064 (0.151)	0.290 (0.654)	-0.614 (0.940)
Priority: local area	-0.640 (0.569)	-2.588 (1.886)	3.520* (1.909)
Priority: region	-0.678** (0.312)	-2.776* (1.458)	1.646 (1.855)
Priority: international	-0.556 (0.667)	-5.250*** (1.988)	-5.734** (2.496)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	-0.004 (0.064)	0.301 (0.303)	-0.571 (0.500)
Off-campus incubator (start-ups)	0.063 (0.110)	0.218 (0.422)	0.292 (0.657)
Science-park space (start-ups)	-0.096 (0.105)	-0.268 (0.370)	-0.642 (0.630)
<b>Market and societal demand</b>			
Business advice (start-ups)	0.067 (0.079)	0.684 (0.525)	1.136 (0.925)
Monitoring of labour markets	0.708 (0.490)	-0.234 (0.804)	-0.209 (0.814)
Employer curriculum design	-0.016 (0.326)	-0.861 (0.747)	-0.255 (1.027)
Exploitation company (owned)	0.372 (0.280)	1.264 (0.880)	0.217 (1.509)
Exploitation company (majority)	0.068 (0.414)	-3.634*** (0.860)	2.940*** (1.019)
Exploitation company (minority)	-0.357 (0.336)	0.389 (0.698)	-2.112 (1.445)
<b>Intermediate and support services</b>			
Internal department for engagement	0.019 (0.170)	2.538*** (0.787)	3.711 (2.451)
Indemnity insurance for staff	-0.523 (0.659)	1.389 (1.817)	1.761 (2.092)
<b>Talent management</b>			
Staff incentives for engagement	-0.046 (0.125)	-1.122 (0.801)	-0.151 (0.918)
Staff rewards for IPR	0.276 (0.298)	-1.975* (1.139)	-1.128 (1.214)
Student placements (central)	-0.194 (0.470)	-0.047 (0.574)	-1.675 (1.226)
Student placements (department)	0.306 (0.248)	-1.258 (1.465)	-3.388** (1.535)
Student placements (ad hoc)	0.688 (0.577)	-0.601 (2.146)	1.437 (2.411)
<b>Knowledge management</b>			
Files IPR in house	0.363 (0.246)	2.133*** (0.568)	1.231 (0.751)
Requires disclosure of inventions	-0.302 (0.351)	3.688*** (1.194)	1.977 (2.238)
<b>Leadership</b>			
Strategic plan (business)	-0.399 (0.434)	-0.706 (0.685)	0.329 (0.548)
Strategic plan (public and civic)	0.042 (0.158)	0.157 (0.405)	-0.104 (0.658)
VC pay (in £100 k)	-0.019 (0.061)	0.402 (0.441)	-0.348 (0.560)
<b>Accessibility of finance</b>			
Seed corn investment (start-ups)	0.071 (0.099)	0.601 (0.457)	-1.262** (0.600)
Venture capital (start-ups)	0.115 (0.121)	-0.586 (0.572)	0.314 (0.727)

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Table 2 (continued)

	Graduate start-ups	Undergraduate employment	Postgraduate employment
Funds for teaching (equipment)	0.097 (0.193)	0.266 (0.602)	-1.201 (1.131)
Graduation year: 2018/2019	-0.127 (0.104)	-4.427*** (0.360)	-1.271** (0.497)
Graduation year: 2019/2020	-0.239 (0.156)	-3.382*** (0.394)	-2.099*** (0.477)
Constant	-1.279 (1.412)	59.324*** (6.518)	63.921*** (9.141)
R <sup>2</sup>	0.12	0.50	0.21
N	423	423	423

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

additional teaching equipment as a result of external engagement activities.

#### 4. Results and discussion

Our first set of regression results, for the models with graduate start-ups and graduate employability as dependent variables are shown in Table 2. All of the outcome variables have been scaled by the graduate population, so they can be interpreted as percentages of the population. The graduate start-ups measure is the percentage of graduates who register a new enterprise within one or two years after graduation, while the two employability measures capture the percentage of graduates (shown separately for undergraduate and postgraduate courses) who are in full-time employment 15 months after graduation. The coefficients show the marginal effect (or where relevant, the effect of a dummy variable switching from 0 to 1) that results from a change in an explanatory variable, i.e., where an institution introduces or changes one of the elements of the intrapreneurial ecosystem, on each of the outcome variables. We should stress that our panel is short, covering only three years, so the scope for variation in institutional culture and policies is limited. Longer panels may pick up additional institutional change effects.

The results in Table 2 highlight a few interesting points, supporting our conceptual discussion in Section 2. Graduate start-ups are affected by university policies for dealing with commercialisation, and by the geographic priorities of the university's stakeholder network. We find that a change in policy towards requiring the use of an internal contracting system increases the level of graduate start-up activity by half a percentage point. Changes to other elements of the university intrapreneurial ecosystem, such as an increase in the availability of incubators or start-up finance, appear to have little effect on graduate start-up activity over our period of analysis. The reason may be that these are more geared towards supporting staff entrepreneurship, given that this has been the focus of most universities over the period in question. A second finding of interest is that student start-ups benefit from changes in institutional strategic outlook towards the national level (the reference category), and away from the regional level. This may reflect greater mobility among graduate entrepreneurs, relative to staff entrepreneurs, who are mostly rooted in the local area.

We now turn to the findings for undergraduate and postgraduate student employability. Changes in the geography of stakeholder networks and related stakeholder preferences are also important here. A shift towards an international focus has a negative effect on both undergraduate and postgraduate student outcomes, with a large coefficient indicating a fall in full-time graduate employment of around 5 percentage points. Interestingly, a shift to local networks has a weakly significant effect on postgraduate employment (of around 3.5 percentage points), whereas a shift to regional networks has a weakly negative effect on undergraduate employment. This suggests that undergraduate employment is linked to national stakeholder networks, presumably due to the greater mobility of undergraduates after graduation, while

postgraduate student employment is also linked to local networks. This may reflect lower mobility, and greater anchoring in a local area that is presumably more specialised in their particular field.

There are a few other interesting differences between the undergraduate and postgraduate employability patterns. We find that a shift towards greater internal commercialisation resources, such as having a dedicated department for commercialisation and engagement, and more structured knowledge management processes, is associated with greater undergraduate employability. This may reflect a better organised knowledge management culture, which may in turn improve access to equipment, and links with potential employers. External factors, such as the outsourcing of exploitation activities to an external organisation (albeit one that is majority owned), is negatively associated with undergraduate employment outcomes. Postgraduate employability, in contrast, is positively affected by the outsourcing of these activities, perhaps due to the likelihood that this outsourcing comes with stronger links to the local entrepreneurship ecosystem, in keeping with the earlier findings on the geography of stakeholder networks. One final interesting point in these regressions is the large and negative values of the coefficients for the year of graduation fixed effects (relative to 2017/2018), capturing the negative impact of the Covid period on graduate employment outcomes.

We now turn to the wellbeing-related measures of job quality, meaningful activity, and perception of the value of the course, shown in Table 3. Interestingly, these regressions show that student perceptions about the value and meaning of the course are more closely associated with engagement between the universities and potential employers, than was the case for the employability outcomes shown in Table 2. This implies that the quality of outcomes and broader benefits beyond those that are purely work-related, and more specifically on good matches between student aspirations and post-graduation outcomes, are closely linked to active institutional understanding and engagement with their market (broadly defined).

Turning to a few specific results, we find that an increase in the percentage of business representatives on the university's governing body is reflected in a small increase in a perception that the course was useful for the current activity. We find similarly positive effects for an institutional shift towards providing more business advice (for student and staff start-ups), and for a shift towards facilitating student placements (in an ad-hoc manner), or better knowledge management in the form of requiring staff to disclose inventions. All of these measures capture the extent of the University's engagement with market and societal demand, as defined by our model in Fig. 1.

As with the employability results in Table 2, we find that a shift in university strategy towards international partners, and in this case, also towards local partners (relative to national partners), reduces student perceptions of the quality and usefulness of the course. It is clear in these regressions that undergraduate students, in particular, benefit greatly from the University's national stakeholder networks, possibly due to the greater job market options this provides, relative to the more specialised local and regional networks that might be more useful for postgraduate

Table 3

Two-way fixed effects regressions with robust standard errors, for graduate wellbeing variables 15 months after graduation.

	Activity is meaningful	Activity fits career plans	Course was useful for activity
<b>Regulations and policies</b>			
Business representatives on board (%)	0.022 (0.022)	0.013 (0.024)	0.046** (0.022)
Civil society representatives on board (%)	0.019 (0.025)	0.027 (0.030)	0.018 (0.024)
Public sector representatives on board (%)	0.012 (0.017)	-0.002 (0.014)	-0.018 (0.013)
Required contracting system	0.780 (0.532)	-0.243 (0.579)	0.113 (0.977)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	0.444 (0.777)	0.346 (0.932)	0.041 (0.470)
<b>Stakeholder networks</b>			
Benefits from business engagement	-0.306 (0.342)	-0.388 (0.511)	0.092 (0.459)
Priority: local area	-1.044 (0.766)	-2.558** (1.284)	-2.226** (1.018)
Priority: region	0.124 (0.728)	0.882 (1.481)	1.114 (1.660)
Priority: international	-3.149*** (0.938)	-4.100*** (1.076)	-2.072 (1.290)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	-0.243 (0.195)	-0.132 (0.160)	-0.027 (0.229)
Off-campus incubator (start-ups)	0.703** (0.309)	0.320 (0.244)	-0.225 (0.374)
Science-park space (start-ups)	-0.384 (0.238)	-0.266 (0.287)	0.054 (0.313)
<b>Market and societal demand</b>			
Business advice (start-ups)	0.599** (0.251)	0.586*** (0.209)	0.991*** (0.308)
Monitoring of labour markets	-0.395 (0.441)	0.013 (0.623)	-0.063 (0.440)
Employer curriculum design	0.307 (0.322)	-0.026 (0.411)	0.083 (0.411)
Exploitation company (owned)	-0.572 (0.686)	0.408 (0.537)	0.361 (0.577)
Exploitation company (majority)	1.772 (1.429)	2.480* (1.415)	0.467 (0.934)
Exploitation company (minority)	-0.689 (1.029)	-1.218 (1.151)	0.816 (0.636)
<b>Intermediate and support services</b>			
Internal department for engagement	-1.632 (1.185)	-0.027 (0.626)	-0.300 (0.720)
Indemnity insurance for staff	1.036 (1.343)	-1.136 (1.520)	1.040 (1.393)
<b>Talent management</b>			
Staff incentives for engagement	-0.411 (0.453)	-0.287 (0.600)	-0.561 (0.407)
Staff rewards for IPR	-2.020 (1.223)	-1.632* (0.932)	-0.849 (0.919)
Student placements (central)	-0.417 (0.508)	-0.053 (0.574)	-0.552 (0.457)
Student placements (department)	-1.488 (1.077)	-0.937 (1.014)	-0.003 (0.669)
Student placements (ad hoc)	0.642 (1.148)	0.958 (1.284)	1.756* (1.030)
<b>Knowledge management</b>			
Files IPR in house	0.519 (0.712)	-0.074 (0.783)	0.221 (0.768)
Requires disclosure of inventions	1.590 (1.103)	0.541 (1.070)	2.429* (1.281)
<b>Leadership</b>			
Strategic plan (business)	0.339 (0.292)	0.601 (0.443)	0.008 (0.415)
Strategic plan (public and civic)	-0.134 (0.362)	-0.166 (0.332)	0.138 (0.282)
VC pay (in £100 k)	-0.284 (0.345)	-0.506** (0.214)	-0.535*** (0.195)
<b>Accessibility of finance</b>			
Seed corn investment (start-ups)	-0.271 (0.384)	-0.503 (0.400)	0.093 (0.439)
Venture capital (start-ups)	0.048 (0.405)	0.238 (0.438)	-0.086 (0.511)

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Table 3 (continued)

	Activity is meaningful	Activity fits career plans	Course was useful for activity
Funds for teaching (equipment)	-0.364 (0.349)	-0.227 (0.462)	0.241 (0.504)
Graduation year: 2018/2019	-1.368*** (0.239)	-2.091*** (0.264)	-1.143*** (0.251)
Graduation year: 2019/2020	-3.826*** (0.248)	-4.510*** (0.278)	-3.204*** (0.268)
Constant	44.789*** (4.676)	42.780*** (5.341)	28.094*** (4.462)
R <sup>2</sup>	0.59	0.63	0.48
N	423	423	423

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

students, and student entrepreneurs.<sup>13</sup> Interestingly, we find that an increase in Vice-Chancellor pay has a significant negative effect on student perceptions about the usefulness of the course. Our interpretation is that higher Vice-Chancellor pay is associated with greater bureaucracy, and a focus on transformative activities other than teaching (such as a greater focus on research, buildings and real estate, expansion of the university to campuses in other countries, etc.), in a way that is negatively perceived by students. Finally, we can see the negative impact of the Covid period on student perceptions of their post-graduation outlook, captured in the large and negative coefficients of the 2018/2019 and 2019/2020 year of graduation dummies, for students surveyed in late 2020 to early 2022.

As we 'close the loop' and position our empirical results in the context of our prior theoretical discussion in Section 2, we can strategically elaborate on the configuration of intrapreneurial ecosystems within the University in relation to graduate entrepreneurship, graduate employment and graduate wellbeing, as well as their biases and possible transformations. In the case of graduate entrepreneurship, it appears from our findings that a shift in focus of the University, as it was anticipated by Siegel and Wright (2015a), beyond staff spinoffs to include more indirect aspects of academic entrepreneurship such as graduate start-ups is yet to fully materialise. It is notable from our results that neither resources nor intrapreneurial capabilities available within the ecosystem have any effect on the number of graduate start-ups. This implies that existing intrapreneurial ecosystems in the University remain strongly predisposed towards supporting staff spinoffs, suggesting a considerable scope for new approaches to enable student and graduate entrepreneurship.

The results on graduate employment and graduate wellbeing are very remarkable in the sense that they indicate that many concerns and even fears about the University becoming overly focused on commercialisation, job creation and 'serving businesses', while overlooking purposes beyond economic gain (Cantwell and Kauppinen, 2014), are somewhat exaggerated. It appears that the University is holding ground as an institution fostering personal and professional development of well-rounded individuals, meaningfully contributing to society. This is evidenced by intrapreneurial ecosystem elements, including intrapreneurial capability elements (Klofsten et al., 2021), being increasingly

geared towards enhancing graduate wellbeing rather than increasing the quantity of graduate jobs.

Consistent with our theoretical discussion about the University being subject to strong institutional pressures emanating from different groups of stakeholders, we find evidence of power imbalances where the expectations of national stakeholders appear to dominate the intrapreneurial environment within universities, making it challenging to create a room for intrapreneurial initiatives for other geographies. We also find support for the 'old' argument about an inefficiency of certain institutionalised 'myths' (Meyer and Rowan, 1977). It appears from the results that having a highly paid University vice-chancellor turns out to be a matter of prestige for the University, rather than an important capability element of the intrapreneurial ecosystem needed to enable creativity and innovation in relation to graduate wellbeing outcomes.

## 5. Conclusions

This study is motivated by a combination of theoretical, empirical, and practical considerations which define its contribution to the field. Firstly, from the theoretical point of view there is a clear need to develop a systemic view on intrapreneurship in academia, departing from partial interpretations of the phenomenon which tend to be skewed toward technology transfer and knowledge commercialisation activities, and overlooking the transverse nature of intrapreneurship which can span across all missions and parts of the University (Rossano-Rivero, 2019). We contribute by offering an inclusive definition of intrapreneurship and placing it at the heart of the elaborated concept of the intrapreneurial ecosystem in academia, accommodating the notion of the University as a complex and idiosyncratic organisation. Strategically, the proposed framework aims to encourage and accelerate research on academic intrapreneurship in contexts outside technology transfer, including those related to learning and teaching, research, civic engagement, reputation building, among others. Using the elaborated intrapreneurial ecosystem framework, we conduct an investigation into relatively unexplored outputs of academic intrapreneurship such as graduate employment and graduate wellbeing. Among the most contributing results are those revealing the apparent predisposition of the academic intrapreneurial ecosystem towards ensuring graduate student satisfaction with the career stage and the role of the university in the graduate career progression rather than simply increasing the number of graduate students obtaining a job or starting a business. Another set of revealing results is related to the implications of strategic shifts toward stakeholder networks with different geographical focus. These suggest that shifts away from the national stakeholder networks are likely to lead to negative effects for graduate perceptions of wellbeing, start-up generation and undergraduate employment in particular. These findings expose serious dilemmas that higher education institutions may face when aiming to increase their international presence or respond to the civic university agenda. Our analysis also reveals the strong negative impact of Covid on both graduate employment outcomes and wellbeing. One action point from this for the academic

<sup>13</sup> Interestingly, this also holds if we run the regression using the outcomes for international students only (shown in tables B4 and B5 of Appendix B). Our results indicate that international students are much more reliant on university-organised student placements, with the use of ad-hoc placements in particular contributing greatly to undergraduate employment outcomes, and perceptions that the course was useful. Graduate career satisfaction among international students is also strongly associated with national stakeholder networks, while an institutional focus on local or international networks is associated with worse career satisfaction outcomes. These results suggest that for many international students, a UK university education is perceived as a springboard for a graduate-level job in the UK, and university activities that focus on maintaining and strengthening national networks are therefore seen as crucial.

intrapreneurial ecosystem can be an enhanced focus on the elements of the ecosystem that can increase its resilience to potential future crises. Finally, as shown by our empirical results, the elaborated intrapreneurial ecosystem framework can easily be translatable as an invaluable diagnostics tool for practitioners (e.g., University management) to systematically evaluate the effectiveness of different parts and functions of the University and to identify areas for an urgent action, as well as medium and long-term strategies.

To summarise the limitations of the study, firstly, as mentioned before, our three-year time frame is relatively short, and a more longitudinal study might reveal additional relationships. Secondly, having elaborated a concept of intrapreneurship in academia with a multiplicity of intrapreneurial outputs, in our empirical part we chose to focus on a particular relatively unexplored set of outputs related to graduate employability and graduate wellbeing. Adding other intriguing outputs to the analysis such as civic engagement would be highly desirable,

although not without data availability challenges. Thirdly, the choice of variables to analyse graduate wellbeing was restricted to post-graduation career activities. Having access to, and analysing, more granular data on the lifestyle of graduates and their life-satisfaction would add further value to our study.

#### CRediT authorship contribution statement

**Maria Abreu:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.  
**Vadim Grinevich:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

#### Data availability

The authors do not have permission to share data.

#### Appendix A. Variables included in the analysis

The following variables were collected by the UK's Higher Education Statistics Agency (HESA) as part of one of the following data collection exercises: (a) the Graduate Outcomes survey, which is sent to all UK graduates 15 months after graduation, (b) the HE-BIC survey, which is completed annually by all public higher education institutions and includes two parts: Part A for qualitative responses, Part B for quantitative responses, or (c) annual administrative data requests. The relevant data source is noted in brackets after each variable description.

##### Output variables:

**Graduate start-ups:** a measure of the percentage of graduates who start a business soon after graduation. It is based on the number of new enterprises created by recent graduates (within one or two years of graduation), scaled by the current number of students. The measure is restricted to enterprises that received some formal support from the institution and are registered with a relevant regulatory body. Any type of enterprise structure is allowed, e.g., sole traders, partnerships, and social enterprises. (HE-BCI Part B).

**Undergraduate employment:** percentage of an institution's undergraduate student cohort in a given year of graduation who are in full-time employment 15 months after graduation. (Graduate Outcomes).

**Postgraduate employment:** percentage of an institution's postgraduate student cohort in a given year of graduation who are in full-time employment 15 months after graduation. (Graduate Outcomes).

**Activity is meaningful:** percentage of an institution's student cohort in a given year of graduation, who strongly agree with the statement "My current activity is meaningful". Current activity includes the following options: paid work for an employer; self-employment or freelancing, running my own business; developing a creative, artistic, or professional portfolio; voluntary or unpaid work for an employer; engaged in a course of study, training, or research; taking time out to travel; caring for someone (unpaid); retired, unemployed, and looking for work; doing something else. (Graduate Outcomes).

**Activity fits career plans:** percentage of an institution's student cohort in a given year of graduation, who strongly agree with the statement "My current activity fits with my future plans". (Graduate Outcomes).

**Course was useful for activity:** percentage of an institution's student cohort in a given year of graduation, who strongly agree with the statement "I am using what I learnt during my studies in my current activity". (Graduate Outcomes).

##### Explanatory variables:

**Business representatives on board (%):** percentage of members on the institution's governing body who are representatives of commercial business. (HE-BCI Part A).

**Civil society representatives on board (%):** percentage of members on the institution's governing body who are representatives of social, community, or cultural groups. (HE-BCI Part A).

**Public sector representatives on board (%):** percentage of members on the institution's governing body who are representatives of public sector organisations. (HE-BCI Part A).

**Required contracting system:** whether the institution has a required contracting system for all staff business and community interaction activities. (HE-BCI Part A).

**Entrepreneurship training (start-ups):** whether the institution offers start-up support via entrepreneurship training. (HE-BCI Part A).

**Benefits from business engagement:** the benefits ultimately delivered with respect to the institution's knowledge exchange priorities, resulting from engagement with commercial private business, on a scale of 1–4. (HE-BCI Part A).

**Priority: local area:** whether the local area is a priority for the institution in terms of knowledge-exchange activities. (HE-BCI Part A).

**Priority: region:** whether the region or nation (for Scotland, Wales, and Northern Ireland) is a priority for the institution in terms of knowledge-exchange activities. (HE-BCI Part A).

**Priority: national:** whether national collaborations are a priority for the institution in terms of knowledge-exchange activities. (HE-BCI Part A).

**Priority: international:** whether international collaborations are a priority for the institution in terms of knowledge-exchange activities. (HE-BCI Part A).

**On campus incubator (start-ups):** whether the institution offers start-up support via this mechanism. (HE-BCI Part A).

- Off-campus incubator (start-ups):* whether the institution offers start-up support via this mechanism (HE-BCI Part A).
- Science-park space (start-ups):* whether the institution offers start-up support via this mechanism. (HE-BCI Part A).
- Business advice (start-ups):* whether the institution offers start-up support via this mechanism. (HE-BCI Part A).
- Monitoring of labour markets:* the extent to which the institution monitors skills needs and sectoral changes through local labour market intelligence, on a scale of 1–5. (HE-BCI Part A).
- Employer curriculum design:* the extent to which employers are actively involved in the development of content and regular reviewing of the institution’s curriculum, on a scale of 1–5. (HE-BCI Part A).
- Exploitation company (owned):* whether the institution has this subsidiary company or department to manage business and community interactions. (HE-BCI Part A).
- Exploitation company (majority):* whether the institution has this subsidiary company or department to manage business and community interactions. (HE-BCI Part A).
- Exploitation company (minority):* whether the institution has this subsidiary company or department to manage business and community interactions. (HE-BCI Part A).
- Internal department for engagement:* whether the institution has this subsidiary company or department to manage business and community interactions. (HE-BCI Part A).
- Indemnity insurance for staff:* whether the institution provides indemnity insurance for staff to cover external engagement activities. (HE-BCI Part A).
- Staff incentives for engagement:* the level of incentives provided for staff to engage with business and community partners, on a scale of 1–5. (HE-BCI Part A).
- Staff rewards for IPR:* whether staff are rewarded (financially or otherwise) for the intellectual property they generate. (HE-BCI Part A).
- Student placements (central):* whether graduate business placements are arranged centrally. (HE-BCI Part A).
- Student placements (department):* whether graduate business placements are arranged via individual schools or departments. (HE-BCI Part A).
- Student placements (ad hoc):* whether graduate business placements are arranged in an ad-hoc way between students and businesses. (HE-BCI Part A).
- Files IPR in house:* whether the institution exerts ownership over intellectual property by filing IPR in house. (HE-BCI Part A).
- Requires disclosure of inventions:* whether the institution requires staff to report or disclose inventions. (HE-BCI Part A).
- Strategic plan (business):* the extent to which the university has developed a strategic plan for business engagement, on a scale of 1–5. (HE-BCI Part A).
- Strategic plan (public and civic):* the extent to which the university has developed a strategic plan for public and community engagement, on a scale of 1–5. (HE-BCI Part A).
- VC pay (in £100k):* the total annual remuneration package for the institution’s Vice Chancellor or equivalent head of institution. (HESA Finance database).
- Seed corn investment (start-ups):* whether the institution offers start-up support via this mechanism. (HE-BCI Part A).
- Venture capital (start-ups):* whether the institution offers start-up support via this mechanism. (HE-BCI Part A).
- Funds for teaching (equipment):* whether the institution’s external engagement activities (linked to local-area regeneration) have provided funds for additional teaching equipment. (HE-BCI Part A).
- Graduation year:* fixed effects that indicate the academic year (of graduation/data collection), with 2017/2018 as the omitted category.

**Appendix B. Additional tables**

**Table B1**  
Descriptive statistics for the variables included in the analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
Graduate start-ups	423	0.80	2.10	0	22
Undergraduate employment	423	53.12	9.31	17	79
Postgraduate employment	423	63.64	9.91	28	87
Activity is meaningful	423	42.83	5.31	25	64
Activity fits career plans	423	38.84	4.79	23	59
Course was useful for activity	423	32.03	5.51	18	56
Business representatives on board (%)	423	37.26	13.02	3.57	76.92
Civil society representatives on board (%)	423	12.03	11.85	0	56.25
Public sector representatives on board (%)	423	28.58	17.09	0	68.18
Required contracting system	423	0.77	0.42	0	1
Entrepreneurship training (start-ups)	423	3.38	0.77	1	4
Benefits from business engagement	423	3.36	0.84	1	4
Priority: local area	423	0.09	0.29	0	1
Priority: region	423	0.34	0.48	0	1
Priority: international	423	0.04	0.19	0	1
On-campus incubator (start-ups)	423	3.15	1.25	1	4
Off-campus incubator (start-ups)	423	1.96	0.95	1	4
Science-park space (start-ups)	423	1.78	1.08	1	4
Business advice (start-ups)	423	3.22	0.73	1	4
Monitoring of labour markets	423	3.79	0.81	1	5
Employer curriculum design	423	4.15	0.95	1	5
Exploitation company (owned)	423	0.46	0.50	0	1
Exploitation company (majority)	423	0.06	0.24	0	1
Exploitation company (minority)	423	0.04	0.19	0	1
Internal department for engagement	423	0.87	0.33	0	1
Indemnity insurance for staff	423	0.92	0.26	0	1

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**Table B1** (continued)

Variable	Obs	Mean	Std. Dev.	Min	Max
Staff incentives for engagement	423	3.78	0.75	2	5
Staff rewards for IPR	423	0.88	0.33	0	1
Student placements (central)	423	0.64	0.48	0	1
Student placements (department)	423	0.93	0.25	0	1
Student placements (ad hoc)	423	0.75	0.44	0	1
Files IPR in house	423	0.39	0.49	0	1
Requires disclosure of inventions	423	0.92	0.27	0	1
Strategic plan (business)	423	4.19	0.82	2	5
Strategic plan (public and civic)	423	3.93	0.95	1	5
VC pay (in £100 k)	423	3.03	0.80	0.90	6.16
Seed corn investment (start-ups)	423	2.48	1.13	1	4
Venture capital (start-ups)	423	1.65	0.75	1	4
Funds for teaching (equipment)	423	0.37	0.48	0	1

**Table B2**

OLS regressions for graduate start-ups and graduate full-time employment 15 months after graduation.

	Graduate start-ups	Undergraduate employment	Postgraduate employment
<b>Regulations and policies</b>			
Business representatives on board (%)	0.028*** (0.008)	-0.008 (0.035)	-0.100*** (0.036)
Civil society representatives on board (%)	-0.001 (0.009)	-0.061 (0.039)	0.033 (0.040)
Public sector representatives on board (%)	0.022*** (0.006)	-0.063** (0.025)	0.022 (0.026)
Required contracting system	-0.534** (0.247)	-0.002 (1.096)	4.094*** (1.119)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	-0.225 (0.140)	0.971 (0.622)	0.080 (0.636)
<b>Stakeholder networks</b>			
Benefits from business engagement	0.836*** (0.153)	0.989 (0.678)	-0.407 (0.693)
Priority: local area	1.275*** (0.367)	-2.627 (1.628)	5.175*** (1.663)
Priority: region	-0.715*** (0.211)	-1.773* (0.937)	1.161 (0.957)
Priority: international	2.591*** (0.529)	0.099 (2.348)	0.685 (2.397)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	0.144* (0.080)	0.144 (0.354)	-0.190 (0.362)
Off-campus incubator (start-ups)	-0.270** (0.109)	0.498 (0.483)	0.234 (0.493)
Science-park space (start-ups)	-0.246** (0.096)	0.170 (0.425)	0.423 (0.434)
<b>Market and societal demand</b>			
Business advice (start-ups)	0.128 (0.146)	2.365*** (0.648)	1.840*** (0.662)
Monitoring of labour markets	0.154 (0.149)	-0.146 (0.660)	-1.660** (0.674)
Employer curriculum design	0.468*** (0.126)	1.774*** (0.561)	0.180 (0.573)
Exploitation company (owned)	-0.252 (0.202)	-2.074** (0.898)	-0.137 (0.917)
Exploitation company (majority)	-0.200 (0.401)	0.538 (1.781)	0.587 (1.819)
Exploitation company (minority)	-0.860* (0.505)	-3.136 (2.241)	-4.854** (2.289)
<b>Intermediate and support services</b>			
Internal department for engagement	-1.134*** (0.291)	-0.709 (1.290)	-3.202** (1.317)
Indemnity insurance for staff	-1.094** (0.448)	4.679** (1.986)	8.015*** (2.028)
<b>Talent management</b>			
Staff incentives for engagement	0.214 (0.145)	-1.614** (0.644)	-1.376** (0.658)
Staff rewards for IPR	0.950** (0.370)	3.329** (1.641)	-1.469 (1.676)
Student placements (central)	-0.458** (0.194)	-2.367*** (0.863)	-0.830 (0.881)
Student placements (department)	-0.022	1.910	-0.222

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**Table B2** (continued)

	Graduate start-ups	Undergraduate employment	Postgraduate employment
Student placements (ad hoc)	(0.408) -0.162 (0.226)	(1.810) 2.009** (1.004)	(1.848) 3.692*** (1.025)
<b>Knowledge management</b>			
Files IPR in house	-0.305 (0.200)	-0.219 (0.886)	-0.230 (0.905)
Requires disclosure of inventions	-1.267*** (0.392)	7.731*** (1.741)	13.521*** (1.778)
<b>Leadership</b>			
Strategic plan (business)	-0.400*** (0.150)	0.635 (0.666)	-0.248 (0.680)
Strategic plan (public and civic)	-0.008 (0.117)	-1.704*** (0.517)	-0.931* (0.528)
VC pay (in £100 k)	-0.329** (0.134)	0.756 (0.593)	0.539 (0.606)
<b>Accessibility of finance</b>			
Seed corn investment (start-ups)	-0.193** (0.089)	0.465 (0.395)	0.640 (0.404)
Venture capital (start-ups)	0.439*** (0.152)	-1.376** (0.675)	0.695 (0.689)
Funds for teaching (equipment)	0.539*** (0.207)	0.062 (0.920)	-0.285 (0.940)
Constant	-0.361 (1.110)	28.618*** (4.924)	50.510*** (5.029)
R2	0.37	0.37	0.42
N	423	423	423

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

**Table B3**

OLS regressions for graduate wellbeing variables 15 months after graduation.

	Activity is meaningful	Activity fits career plans	Course was useful for activity
<b>Regulations and policies</b>			
Business representatives on board (%)	-0.114*** (0.022)	-0.092*** (0.020)	-0.048** (0.022)
Civil society representatives on board (%)	-0.008 (0.025)	-0.010 (0.022)	-0.031 (0.025)
Public sector representatives on board (%)	-0.039** (0.016)	-0.048*** (0.014)	-0.014 (0.016)
Required contracting system	-0.524 (0.692)	-1.067* (0.626)	-1.396** (0.703)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	-0.645 (0.393)	-0.435 (0.356)	-1.107*** (0.399)
<b>Stakeholder networks</b>			
Benefits from business engagement	-1.500*** (0.429)	-0.426 (0.388)	-1.914*** (0.435)
Priority: local area	-1.058 (1.029)	-1.988** (0.931)	-1.977* (1.045)
Priority: region	0.006 (0.592)	-0.633 (0.536)	-0.151 (0.601)
Priority: international	-2.080 (1.483)	-1.379 (1.342)	-3.541** (1.506)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	0.435* (0.224)	0.131 (0.202)	0.411* (0.227)
Off-campus incubator (start-ups)	0.162 (0.305)	-0.056 (0.276)	-0.432 (0.310)
Science-park space (start-ups)	0.520* (0.268)	0.575** (0.243)	0.081 (0.272)
<b>Market and societal demand</b>			
Business advice (start-ups)	1.352*** (0.410)	0.482 (0.371)	1.314*** (0.416)
Monitoring of labour markets	-0.252 (0.417)	-0.566 (0.377)	0.086 (0.423)
Employer curriculum design	0.667* (0.354)	0.670** (0.321)	0.786** (0.360)
Exploitation company (owned)	0.230 (0.567)	-0.138 (0.513)	0.275 (0.576)
Exploitation company (majority)	-0.699 (1.126)	-0.962 (1.018)	-1.099 (1.143)
Exploitation company (minority)	-0.604 (1.416)	0.056 (1.281)	0.676 (1.438)

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**Table B3** (continued)

	Activity is meaningful	Activity fits career plans	Course was useful for activity
Intermediate and support services			
Internal department for engagement	0.475 (0.815)	0.097 (0.737)	0.822 (0.827)
Indemnity insurance for staff	1.815 (1.255)	2.301** (1.135)	0.920 (1.274)
Talent management			
Staff incentives for engagement	-0.026 (0.407)	-0.062 (0.368)	-0.302 (0.413)
Staff rewards for IPR	-0.322 (1.037)	-0.026 (0.938)	0.023 (1.053)
Student placements (central)	-0.390 (0.545)	-0.824* (0.493)	-1.272** (0.553)
Student placements (department)	0.475 (1.144)	0.891 (1.034)	2.478** (1.161)
Student placements (ad hoc)	-0.361 (0.634)	0.104 (0.574)	-1.877*** (0.644)
Knowledge management			
Files IPR in house	0.489 (0.560)	0.357 (0.506)	0.184 (0.568)
Requires disclosure of inventions	1.953* (1.100)	0.236 (0.995)	-0.337 (1.117)
Leadership			
Strategic plan (business)	1.079** (0.421)	1.064*** (0.381)	1.139*** (0.427)
Strategic plan (public and civic)	-0.623* (0.327)	-0.623** (0.296)	-0.169 (0.332)
VC pay (in £100 k)	-0.260 (0.375)	-0.099 (0.339)	-0.389 (0.381)
Accessibility of finance			
Seed corn investment (start-ups)	0.010 (0.250)	-0.157 (0.226)	-0.663*** (0.254)
Venture capital (start-ups)	-0.177 (0.426)	0.220 (0.386)	0.405 (0.433)
Funds for teaching (equipment)	-0.968* (0.582)	-1.027* (0.526)	-0.347 (0.590)
Constant	42.954*** (3.111)	40.528*** (2.814)	35.571*** (3.159)
R2	0.23	0.22	0.26
N	423	423	423

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

**Table B4**

Two-way fixed effects regressions with robust standard errors, for graduate start-ups and graduate full-time employment 15 months after graduation. International students only.

	Graduate start-ups	Undergraduate employment	Postgraduate employment
<b>Regulations and policies</b>			
Business representatives on board (%)	0.018 (0.017)	0.033 (0.069)	0.030 (0.060)
Civil society representatives on board (%)	-0.012 (0.013)	-0.001 (0.064)	0.194** (0.089)
Public sector representatives on board (%)	0.011 (0.008)	0.044 (0.037)	-0.049 (0.055)
Required contracting system	0.503** (0.201)	-0.201 (2.079)	0.600 (2.028)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	-0.119 (0.224)	-0.879 (1.063)	2.015** (0.919)
<b>Stakeholder networks</b>			
Benefits from business engagement	-0.064 (0.151)	-2.338 (1.483)	-1.289 (1.759)
Priority: local area	-0.640 (0.569)	-6.228 (4.963)	-1.365 (5.092)
Priority: region	-0.678** (0.312)	-1.606 (2.993)	0.324 (2.240)
Priority: international	-0.556 (0.667)	5.107 (7.216)	0.180 (8.476)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	-0.004 (0.064)	-0.410 (0.966)	0.293 (0.737)
Off-campus incubator (start-ups)	0.063 (0.110)	0.555 (0.629)	-0.120 (0.701)

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**Table B4** (continued)

	Graduate start-ups	Undergraduate employment	Postgraduate employment
Science-park space (start-ups)	-0.096 (0.105)	0.542 (0.587)	-2.055** (0.833)
<b>Market and societal demand</b>			
Business advice (start-ups)	0.067 (0.079)	1.497 (2.222)	1.806 (3.240)
Monitoring of labour markets	0.708 (0.490)	1.595 (1.550)	-0.371 (1.405)
Employer curriculum design	-0.016 (0.326)	-3.080** (1.280)	-0.454 (1.575)
Exploitation company (owned)	0.372 (0.280)	-0.285 (2.070)	0.115 (2.364)
Exploitation company (majority)	0.068 (0.414)	-0.499 (3.556)	5.827 (4.078)
Exploitation company (minority)	-0.357 (0.336)	-3.281 (4.116)	-5.115** (2.179)
<b>Intermediate and support services</b>			
Internal department for engagement	0.019 (0.170)	2.113 (1.739)	1.629 (2.220)
Indemnity insurance for staff	-0.523 (0.659)	15.577 (9.630)	
<b>Talent management</b>			
Staff incentives for engagement	-0.046 (0.125)	3.955*** (1.166)	1.540 (1.538)
Staff rewards for IPR	0.276 (0.298)	7.195*** (1.735)	-0.620 (1.954)
Student placements (central)	-0.194 (0.470)	1.323 (1.550)	1.323 (1.896)
Student placements (department)	0.306 (0.248)	-1.992 (2.619)	-4.737 (3.241)
Student placements (ad hoc)	0.688 (0.577)	20.226*** (7.529)	5.539 (5.610)
<b>Knowledge management</b>			
Files IPR in house	0.363 (0.246)	3.747** (1.816)	-0.187 (0.707)
Requires disclosure of inventions	-0.302 (0.351)	-3.837 (3.564)	0.111 (2.652)
<b>Leadership</b>			
Strategic plan (business)	-0.399 (0.434)	-0.860 (1.559)	0.270 (1.090)
Strategic plan (public and civic)	0.042 (0.158)	-0.993 (0.822)	-0.947 (1.003)
VC pay (in £100 k)	-0.019 (0.061)	0.753 (0.875)	-0.384 (0.618)
<b>Accessibility of finance</b>			
Seed corn investment (start-ups)	0.071 (0.099)	-1.322 (0.954)	-1.991** (0.936)
Venture capital (start-ups)	0.115 (0.121)	0.716 (1.038)	1.963** (0.886)
Funds for teaching (equipment)	0.097 (0.193)	0.063 (1.711)	-1.995* (1.184)
Constant	-1.279 (1.412)	9.671 (21.622)	53.997*** (18.072)
R2	0.12	0.28	0.20
N	423	361	337

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

**Table B5**

Two-way fixed effects regressions with robust standard errors, for graduate wellbeing variables 15 months after graduation. International students only.

	Activity is meaningful	Activity fits career plans	Course was useful for activity
<b>Regulations and policies</b>			
Business representatives on board (%)	-0.002 (0.047)	-0.029 (0.046)	-0.007 (0.043)
Civil society representatives on board (%)	0.029 (0.070)	0.063 (0.077)	-0.034 (0.073)
Public sector representatives on board (%)	0.029 (0.040)	0.027 (0.040)	-0.028 (0.040)
Required contracting system	6.644 (5.743)	3.844 (4.886)	0.111 (2.316)
<b>Culture and values</b>			
Entrepreneurship training (start-ups)	1.054 (1.919)	1.020 (1.383)	-0.212 (1.282)
<b>Stakeholder networks</b>			

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Table B5 (continued)

	Activity is meaningful	Activity fits career plans	Course was useful for activity
Benefits from business engagement	-1.041 (1.077)	-1.671 (1.059)	-3.227*** (1.061)
Priority: local area	-6.141*** (2.085)	-10.591** (4.303)	-14.030*** (2.277)
Priority: region	-0.649 (3.899)	0.171 (3.635)	-1.762 (2.927)
Priority: international	-2.759 (3.987)	-12.135*** (4.546)	-10.305*** (3.039)
<b>Infrastructure and workspace</b>			
On-campus incubator (start-ups)	-0.372 (0.597)	-0.717 (0.721)	-0.886 (0.638)
Off-campus incubator (start-ups)	1.279*** (0.474)	-0.188 (0.659)	-1.372 (1.346)
Science-park space (start-ups)	-2.156*** (0.761)	-0.415 (0.792)	0.146 (0.859)
<b>Market and societal demand</b>			
Business advice (start-ups)	1.205 (1.238)	0.390 (1.266)	2.664 (1.710)
Monitoring of labour markets	-2.710** (1.262)	-0.961 (1.464)	-0.304 (1.094)
Employer curriculum design	1.268 (1.208)	2.087 (1.316)	0.229 (0.908)
Exploitation company (owned)	-3.404** (1.685)	-0.520 (1.393)	-3.152 (2.047)
Exploitation company (majority)	2.932 (2.443)	0.404 (1.837)	-3.211* (1.648)
Exploitation company (minority)	-1.546 (2.017)	-3.685*** (1.322)	-1.767 (1.779)
<b>Intermediate and support services</b>			
Internal department for engagement	-3.572** (1.514)	6.717 (4.712)	3.925 (4.930)
Indemnity insurance for staff	-7.624 (8.739)	1.035 (10.859)	17.413* (8.984)
<b>Talent management</b>			
Staff incentives for engagement	2.858** (1.120)	2.617** (1.080)	3.872*** (1.237)
Staff rewards for IPR	-7.367** (3.363)	-3.691*** (1.411)	-10.070* (5.614)
Student placements (central)	0.462 (1.572)	1.485 (2.890)	1.389 (1.947)
Student placements (department)	2.241* (1.281)	-0.077 (2.259)	-3.670 (3.447)
Student placements (ad hoc)	2.012 (3.647)	6.256* (3.186)	14.136*** (3.443)
<b>Knowledge management</b>			
Files IPR in house	-2.519 (2.315)	-1.105 (1.664)	-2.028 (1.886)
Requires disclosure of inventions	1.506 (3.954)	-1.403 (1.636)	-0.371 (1.759)
<b>Leadership</b>			
Strategic plan (business)	1.231* (0.639)	-0.362 (1.275)	-1.365 (0.994)
Strategic plan (public and civic)	-1.033 (0.696)	-0.400 (0.771)	-0.162 (0.628)
VC pay (in £100 k)	-0.361 (0.381)	-0.208 (0.597)	-0.133 (0.439)
<b>Accessibility of finance</b>			
Seed corn investment (start-ups)	-0.111 (0.487)	0.228 (0.548)	0.166 (1.271)
Venture capital (start-ups)	-0.400 (0.676)	0.344 (0.714)	0.360 (1.270)
Funds for teaching (equipment)	-0.452 (1.181)	0.663 (0.962)	0.831 (1.086)
Constant	41.634** (16.947)	18.634 (17.782)	17.187 (16.632)
R2	0.32	0.30	0.27
N	403	404	404

Omitted category for priority area is "Priority: national", omitted category for graduation year is "2017/2018". Robust standard errors shown in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10.

Appendix C. Table of correlations

	Graduate start-ups	Undergraduate employment	Postgraduate employment	Activity is meaningful	Activity fits plans	Course was useful	Business representatives	Civil society representatives	Public sector representatives
Graduate start-ups	1.000								
Undergraduate employment	-0.278	1.000							
Postgraduate employment	-0.260	0.517	1.000						
Activity is meaningful	-0.325	0.410	0.354	1.000					
Activity fits plans	-0.289	0.438	0.533	0.898	1.000				
Course was useful	-0.091	0.173	0.003	0.774	0.704	1.000			
Business representatives	0.165	-0.036	-0.214	-0.285	-0.277	-0.110	1.000		
Civil society representatives	0.036	-0.221	-0.064	0.007	-0.020	-0.027	-0.212	1.000	
Public sector representatives	0.110	-0.031	0.134	-0.052	-0.130	0.001	-0.107	-0.042	1.000
Required contracting system	-0.104	0.161	0.154	-0.049	-0.050	-0.084	0.153	-0.119	0.113
Entrepreneurship training	-0.061	0.195	0.144	-0.008	-0.075	-0.115	0.082	-0.131	0.064
Benefits from business engagement	0.044	0.230	0.060	-0.072	0.065	-0.207	0.016	-0.264	-0.005
Priority: local area	0.154	-0.125	0.025	-0.069	-0.148	-0.070	0.101	0.084	-0.081
Priority: region	-0.060	-0.008	0.051	-0.016	-0.063	0.002	-0.013	0.008	0.161
Priority: international	0.074	-0.057	0.006	-0.078	-0.023	-0.129	-0.002	0.009	-0.128
On-campus incubator (start-ups)	-0.013	0.176	0.105	0.106	0.081	0.037	-0.009	-0.114	-0.072
Off-campus incubator (start-ups)	-0.104	0.160	0.133	0.018	0.048	-0.158	-0.065	-0.126	0.045
Science-park space (start-ups)	-0.142	0.140	0.093	0.083	0.149	-0.075	-0.065	-0.220	-0.092
Business advice (start-ups)	0.047	0.165	0.090	0.201	0.073	0.147	-0.040	-0.037	0.030
Monitoring of labour markets	0.144	0.078	-0.138	-0.035	-0.060	0.045	0.183	-0.162	0.168
Employer curriculum design	0.192	0.129	-0.061	0.077	0.004	0.182	0.212	-0.089	0.243
Exploitation company (owned)	0.005	0.050	0.073	-0.002	0.015	-0.043	0.028	-0.252	0.000
Exploitation company (majority)	-0.060	-0.082	-0.063	-0.030	-0.042	-0.012	0.042	-0.026	-0.077
Exploitation company (minority)	-0.003	-0.021	-0.069	-0.045	-0.030	0.003	0.112	-0.031	-0.058
Internal department for engagement	-0.230	0.047	-0.055	-0.035	0.002	-0.049	0.047	-0.173	0.013
Indemnity insurance for staff	-0.201	0.325	0.333	0.072	0.125	-0.075	-0.060	-0.125	0.107
Staff incentives for engagement	0.104	-0.017	-0.154	0.017	0.072	-0.013	-0.007	-0.237	-0.055
Staff rewards for IPR	-0.036	0.297	0.202	-0.034	0.051	-0.155	-0.038	-0.226	-0.023
Student placements (central)	-0.110	-0.109	-0.039	-0.069	-0.151	-0.127	0.123	0.024	0.126
Student placements (department)	-0.074	0.137	0.110	0.065	0.110	0.078	-0.172	-0.084	0.040
Student placements (ad hoc)	-0.062	0.144	0.195	-0.017	0.026	-0.125	-0.082	-0.179	0.099
Files IPR in house	-0.134	0.103	0.088	0.042	0.087	-0.050	0.038	-0.230	-0.104
Requires disclosure of inventions	-0.199	0.383	0.425	0.094	0.076	-0.077	-0.044	-0.329	0.108
Strategic plan (business)	0.003	0.090	-0.089	0.048	0.078	0.067	0.173	-0.210	0.086
Strategic plan (public and civic)	-0.003	-0.142	-0.213	-0.087	-0.064	-0.020	0.175	-0.077	-0.027
VC pay (in £100k)	-0.182	0.180	0.161	-0.017	0.073	-0.140	-0.027	-0.272	-0.148
Seed corn investment (start-ups)	-0.054	0.141	0.179	0.011	0.000	-0.168	0.019	-0.111	0.053
Venture capital (start-ups)	0.002	0.066	0.127	0.005	0.089	-0.079	-0.067	-0.194	0.071
Funds for teaching (equipment)	0.041	0.095	0.060	-0.043	-0.069	-0.030	-0.013	-0.042	0.108

	Required contracting system	Entrepren. training	Benefits from business engagement	Priority: local area	Priority: region	Priority: international	On-campus incubator (start-ups)	Off-campus incubator (start-ups)	Science-park space (start-ups)
Required contracting system	1.000								
Entrepreneurship training	0.089	1.000							
Benefits from business engagement	0.246	0.023	1.000						
Priority: local area	-0.208	0.185	-0.302	1.000					
Priority: region	-0.033	0.087	0.108	-0.233	1.000				
Priority: international	-0.047	-0.095	-0.097	-0.062	-0.139	1.000			
On-campus incubator (start-ups)	0.190	0.245	0.214	-0.038	-0.085	-0.053	1.000		
Off-campus incubator (start-ups)	0.213	0.063	0.415	-0.164	-0.058	-0.046	0.160	1.000	
Science-park space (start-ups)	0.100	0.052	0.349	-0.164	-0.080	0.040	0.241	0.317	1.000
Business advice (start-ups)	-0.112	0.346	-0.002	0.101	0.053	-0.147	0.024	0.003	-0.027
Monitoring of labour markets	0.214	0.164	0.272	-0.187	0.059	-0.109	0.169	0.109	0.166
Employer curriculum design	0.134	0.113	-0.043	-0.119	0.187	-0.287	-0.094	-0.070	-0.092
Exploitation company (owned)	-0.017	0.103	0.248	-0.038	-0.105	0.054	0.169	0.054	0.173
Exploitation company (majority)	-0.030	-0.163	0.013	0.022	0.051	-0.048	-0.005	-0.084	0.080
Exploitation company (minority)	0.049	0.014	0.093	0.063	0.014	0.029	0.135	-0.031	-0.016
Internal department for engagement	0.246	0.025	0.180	-0.070	-0.082	0.073	-0.001	0.095	0.124
Indemnity insurance for staff	0.354	0.177	0.357	-0.244	-0.019	0.055	0.255	0.213	0.188
Staff incentives for engagement	0.059	0.050	0.315	-0.133	-0.070	0.090	0.024	0.163	0.184
Staff rewards for IPR	0.292	0.130	0.452	-0.076	-0.048	-0.006	0.239	0.271	0.255
Student placements (central)	-0.050	0.102	-0.106	-0.007	-0.075	-0.041	-0.065	0.009	0.002
Student placements (department)	0.164	-0.084	0.071	-0.104	-0.139	0.052	0.211	0.077	0.151
Student placements (ad hoc)	-0.059	0.021	0.047	0.021	-0.107	0.023	0.055	0.067	0.110
Files IPR in house	0.058	0.040	0.201	0.005	-0.070	-0.023	0.065	0.069	0.243
Requires disclosure of inventions	0.170	0.090	0.261	-0.202	0.067	0.057	0.194	0.207	0.188
Strategic plan (business)	0.272	0.086	0.338	-0.105	-0.157	-0.092	0.201	0.174	0.161
Strategic plan (public and civic)	0.106	-0.036	0.119	-0.086	-0.160	0.028	0.047	0.135	0.166
VC pay (in £100k)	0.053	0.133	0.180	-0.070	-0.161	0.223	0.149	0.119	0.264
Seed corn investment (start-ups)	0.104	0.223	0.219	0.047	-0.036	-0.037	0.120	0.187	0.160
Venture capital (start-ups)	0.169	0.114	0.354	-0.207	-0.006	0.037	0.248	0.401	0.333
Funds for teaching (equipment)	0.135	0.144	0.010	-0.045	-0.012	-0.146	0.174	0.078	0.221

	Business advice (start-ups)	Monitoring of labour markets	Employer curriculum design	Exploitation company (owned)	Exploitation company (majority)	Exploitation company (minority)	Internal department for engagement	Indemnity insurance for staff	Staff incentives for engagement
Business advice (start-ups)	1.000								
Monitoring of labour markets	0.048	1.000							
Employer curriculum design	0.262	0.427	1.000						
Exploitation company (owned)	0.052	0.140	-0.060	1.000					
Exploitation company (majority)	0.006	-0.034	0.003	0.111	1.000				
Exploitation company (minority)	0.042	0.113	0.113	0.215	0.213	1.000			
Internal department for engagement	-0.117	0.006	-0.105	-0.117	0.096	0.076	1.000		
Indemnity insurance for staff	0.014	0.059	-0.116	0.192	-0.042	0.057	0.185	1.000	
Staff incentives for engagement	0.067	0.296	0.186	0.071	0.073	0.058	0.050	0.096	1.000
Staff rewards for IPR	-0.183	0.126	-0.101	0.243	0.002	0.074	0.159	0.546	0.103
Student placements (central)	0.089	0.083	0.073	0.036	0.065	0.047	0.020	-0.012	-0.095
Student placements (department)	-0.149	0.092	-0.056	0.156	0.068	0.054	0.149	0.241	0.034
Student placements (ad hoc)	-0.069	0.084	-0.023	0.121	0.008	0.030	0.103	0.080	-0.024
Files IPR in house	-0.086	0.012	-0.096	0.086	0.024	-0.159	0.075	0.157	0.117
Requires disclosure of inventions	-0.137	0.150	0.037	0.167	-0.037	0.059	0.069	0.343	0.030
Strategic plan (business)	0.040	0.517	0.241	0.075	-0.059	0.029	0.150	0.154	0.422
Strategic plan (public and civic)	0.010	0.274	-0.078	-0.034	0.146	-0.050	0.142	0.044	0.350
VC pay (in £100k)	-0.155	-0.027	-0.198	0.179	-0.025	0.075	0.115	0.250	0.174
Seed corn investment (start-ups)	0.203	0.003	0.096	0.130	0.008	0.047	0.001	0.178	0.082
Venture capital (start-ups)	-0.063	0.205	-0.001	0.221	0.008	0.124	0.041	0.190	0.216
Funds for teaching (equipment)	-0.098	0.254	0.067	0.108	-0.128	0.029	-0.018	0.088	-0.002

	Staff rewards for IPR	Student placements (central)	Student placements (department)	Student placements (ad hoc)	Files IPR in house	Requires disclosure of inventions	Strategic plan (business)	Strategic plan (public and civic)	VC pay (in £100k)
Staff rewards for IPR	1.000								
Student placements (central)	-0.059	1.000							
Student placements (department)	0.212	-0.147	1.000						
Student placements (ad hoc)	0.147	0.091	0.337	1.000					
Files IPR in house	0.242	-0.066	0.084	0.089	1.000				
Requires disclosure of inventions	0.366	0.029	0.126	0.148	0.202	1.000			
Strategic plan (business)	0.140	-0.003	0.052	0.110	0.185	0.112	1.000		
Strategic plan (public and civic)	0.093	0.092	0.117	0.087	0.174	-0.124	0.456	1.000	
VC pay (in £100k)	0.341	-0.059	0.071	0.145	0.271	0.317	0.100	0.074	1.000
Seed corn investment (start-ups)	0.141	0.042	0.075	0.120	0.131	0.042	0.117	0.154	0.094
Venture capital (start-ups)	0.270	-0.086	0.087	0.138	0.209	0.189	0.258	0.154	0.322
Funds for teaching (equipment)	0.165	0.076	0.168	0.228	-0.028	0.135	0.104	-0.055	0.013

	Seed corn investment (start-ups)	Venture capital (start-ups)	Funds for teaching (equipment)
Seed corn investment (start-ups)	1.000		
Venture capital (start-ups)	0.367	1.000	
Funds for teaching (equipment)	-0.018	0.016	1.000

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