1. University–industry collaboration: why it matters

1.1 INTRODUCTION

The role universities have evolved, with their ‘traditional’ functions of teaching and research increasingly complemented by a ‘third mission’. This mission focuses on their engagement with industry and their interaction with businesses (Dasgupta and David 1994; Huggins, Prokop, and Thompson 2020; Johnston 2019; Liu, Subramanian, and Hang 2020; Thursby and Thursby 2002). This broadening of the activities of universities has seen them move away from operating as ‘ivory towers’ that are one step removed from society and regarded as aloof and distant. Instead, the modern university is required to behave in the opposite way.

Universities have always had a significant social impact (Hermannsson et al. 2017). For example, their so-called ‘first mission’, which concentrates on teaching and training via undergraduate and postgraduate courses, provides society with stocks of human capital through embedding knowledge within graduates who then apply it in the workplace. Furthermore, the university’s ‘second mission’, centring on undertaking research and the development of new knowledge, contributes to society through building and enhancing the science base, thereby providing knowledge, and the technologies to enable societal innovation and progress. Consequently, as the impacts of universities have widened, they are no longer discussed in terms of a single ‘role’ but multiple ‘roles’.

Universities also make a significant economic impact at both a national and regional level (Guerrero, Cunningham, and Urbano 2015; Marques et al. 2019; Valero and Van Reenen 2019; World Bank 2017). For example, university research and development (R&D) has been found to increase both gross domestic product (GDP) and productivity in an economy (Martin 1998), as well as promoting patenting activity (Jaffe 1989), therefore boosting growth and prosperity (World Bank 2017). At the sub-national level, universities have a significant impact on regional economies as higher numbers are associated with faster regional growth (Valero and Van Reenen 2019), with regional growth being positively influenced by teaching, research, and entrepreneur-

ial activities of universities (Guerrero, Cunningham, and Urbano 2015). Therefore, universities have a broad economic impact on their host regions, be they rural or urban in character, from an economic as well as an innovation perspective (Charles 2016; Charles and Benneworth 2002; Huggins and Johnston 2009b; Salomaa 2019).

The reframing of universities as key actors in the modern economy is therefore captured in the refocusing of universities' activities away from concentrating purely on research to an accompanying emphasis on 'impact' (Doyle 2018; Soetanto and Jack 2016; Woolcott, Keast, and Pickernell 2020). Fostering this impact increasingly involves the collaboration of universities with industry in order to commercialise the 'knowledge base', that is, to ensure the work of universities is *directly* utilised by firms for competitive means (Fini et al. 2018; Jessop 2017).

The re-conceptualisation of the university also reflects a fundamental re-evaluation of the nature and characteristics of the innovation process. In the past, the competitive position of firms was typically regarded as governed by the knowledge resources they possessed (Barney 1991; Dosi 1990; Grant 1996), which in turn determined firms' ability to innovate. However, scholars increasingly recognise that these resources are not decided by the firm's ability to create knowledge alone but its ability to combine this with the procurement of knowledge from external resources. Innovation, therefore, is increasingly regarded as a socio-technical and open process of inter-organisational collaboration, facilitated by networks and alliances designed to access knowledge from external partners (Chesbrough 2003, 2017; Enkel, Gassmann, and Chesbrough 2009; Perkmann and Walsh 2007).

University–industry collaboration refers to activities that focus on the engagement of these parties that develop and utilise knowledge, technology, or expertise for the development of new goods, services, or processes (Ankrah and Al-Tabbaa 2015; Perkmann et al. 2013). Therefore, these collaborations can be viewed as a spectrum of activities ranging from informal interactions at a personal level through to the creation of new legal entities to pursue a joint venture (Bonaccorsi and Piccaluga 1994). The focus of this book is on the formal collaboration of universities and businesses, developed in order to pursue the creation or exploitation of a new technology and the development of new products or services, new processes, or new organisational structures or forms and funded through a public grant.

The motivations for engaging in this type of collaboration are well documented. Firms benefit significantly from working with universities including increased understanding of technologies, greater levels of knowledge, the development of patents, enhanced problem-solving capabilities, recruitment of graduate employees, training opportunities, and cost reductions/efficiencies within the business (Abreu et al. 2008; Bishop, D'Este, and Neely 2011; Hagerdoorn,

Link, and Vonortas 2000; Lööf and Broström 2006). These advantages may fundamentally alter the competitiveness of a firm to enable increased sales and the broadening of the scope of their activities (Abreu et al. 2008; Hagerdoorn, Link, and Vonortas 2000; Lööf and Broström 2006). In addition, firms collaborating with a university are more likely to increase R&D expenditure and R&D employment than non-collaborators (Scandura 2016). Finally, there is evidence that firms that receive public funding to support their research experience faster subsequent growth in employment and sales than those firms that did not (Vanino, Roper, and Becker 2019).

Despite the apparent advantages, two significant points must be noted: (1) universities are typically rated lower than other actors such as customers, suppliers, and rival firms as sources of external knowledge; and (2) this lack of engagement may be explained by a number of significant barriers that may exist with respect to the facilitation of links between firms and universities (Freel 2000; Hewitt-Dundas, Gkypali, and Roper 2019; Hughes and Kitson 2012).

This book concentrates on collaborations occurring between Small and Medium Sized Enterprises (SMEs) and universities. From the perspective of an SME and the entrepreneurs running it, innovation can be a risky and costly endeavour as it consumes time and resources, both of which are limited in the context of smaller firms (Christensen 1997). The rationale for the focus on small firms is based on the fact that they possess fewer resources with which to innovate (Acs and Audretsch 1990; Huggins and Johnston 2009a), and thus stand to gain a greater benefit from engaging in U–I linkages (Motohashi 2005). Yet, firm size is typically regarded to be negatively related to the propensity to engage in collaborative linkages with universities (Laursen and Salter 2004; Mohnen and Hoareau 2003).

While existing studies suggest that SMEs may be less likely to engage in university collaboration than their larger counterparts, this finding masks several significant differences in the form and function of university collaborations for SMEs (Johnston 2020b). As a result, several important differences in the behaviour of SMEs in terms of university collaboration have been observed, including:

- SMEs are less likely to engage in formal collaborations with universities.
- SMEs are more likely to undertake a higher number of collaborations once they engage with a university.
- The outcomes of collaborations between SMEs and universities are less likely to result in a patent (and when they do, they are less likely to be cited in the development of a new patent).
- SMEs are less likely to recruit new employees through university collaboration.
- SMEs may perceive fewer barriers to U–I collaboration.
- SMEs are more likely to collaborate with local universities.

There are also studies which find that firm size is not a significant determinant of university collaboration, or that it is not SMEs that are less likely to engage in these links but only the very smallest, micro, firms (Eom and Lee 2010; Maietta 2015). Furthermore, other studies have suggested that firm size may have a negative effect on the propensity to collaborate with universities, meaning SMEs are more likely to engage in this manner (Hewitt-Dundas 2011). Finally, the influence of firm size on U–I collaboration may be context specific, with Giuliani and Arza's (2009) study of wine producing firms in Italy and Chile finding that in Chile larger firms were more likely to partner with a university, whereas in Italy smaller firms were more likely.

Given the mixed evidence as to the engagement of SMEs and universities as well as their potential benefits and drawbacks, this book aims to shed greater light on collaborations between SMEs and universities. This allows a thorough examination of the socio-technical factors underpinning the motivations, processes, and means through which SMEs develop collaborative links with universities to better inform both theory and policy. As such, this book provides a comprehensive account of collaborations between SMEs and universities. Through following Kim, Kumar, and Kumar's (2010) overview of the typical structure of a collaborative project, the following analysis documents the journey of SMEs through the process of university collaboration starting with how they develop their project and identify their needs for knowledge and expertise; assessing universities and selecting a partner; undertaking the collaboration; and evaluating the outcomes of the partnership (Kim, Kumar, and Kumar 2010).

This first chapter briefly introduces the conceptual and policy background to U–I collaboration and sets the scene for the chapters that follow. In addition, it outlines the empirical approach of the book in terms of outlining the origin of the material that underpins the empirical chapters

1.2 THE ROLE(S) OF UNIVERSITIES

There exists a long-standing academic interest in the roles and performance of universities in the economy. Theorists have long highlighted the importance of firm resources for growth and competitiveness (Penrose 1959), with explicit links made to knowledge and its crucial role in economic growth but also the need for learning-by-doing within firms in order to exploit this resource (Arrow 1962; Mokyr 2002). Consequently, while knowledge was increasingly seen as an important factor of production there were only sporadic attempts to understand the roles of knowledge creators, such as universities, in the economy.

It was Jaffe's seminal 1989 paper that started in earnest a period of intense scrutiny of the roles of universities not merely within the innovation process

but also in the wider economic development process by empirically demonstrating the existence of knowledge spillovers from academic research into the wider economy (Jaffe 1989). This finding prompted an increased empirical focus on the roles of universities in the innovation process through the following decade (Feldman 1999; Henderson and Cockburn 1996; Mansfield 1995, 1998), particularly as accompanying theoretical developments around clusters and systems of innovation became popular policy tools for the purposes of economic development (Drejer, Kristensen, and Laursen 1999; Freeman 1992; Legendijk and Charles 1999; Lundvall 1992; Nelson and Rosenberg 1993; Porter 1990, 2003).

Developments in the theories of clusters and innovation systems increasingly pointed to the importance of what Porter (1990, 2003) termed ‘associated institutions’, that is, non-business organisations that may play a part in the innovation process. As academics recognised the increasingly ‘open’ nature of the innovation process, it became ever more understood as resulting from interactions outside the boundaries of the firm, facilitated through inter-organisational networks (Chesbrough 2003; Dosi 1990). Within these debates, universities were often identified as important partners (Charles 2006; Chatterton and Goddard 2000; Goddard 1999; Goddard and Chatterton 1999), prompting greater policy interest in the phenomenon.

Consequently, a broad literature examining the phenomenon of university–industry (U–I) links now exists (Ankrah and Al-Tabbaa 2015; Geuna and Muscio 2009; Perkmann et al. 2013). However, it is not just open innovation that underpins this as the conceptual foundations of this work are broader than a single framework or theory (Cunningham and O’Reilly 2018).

At a macro level, the U–I links literature draws on the science and public policy literature that examines innovation policy in enabling U–I links (Flanagan and Uyarra 2016; Mazzucato 2016). Furthermore, the literature focuses on the role of institutions, in a broad sense, that enable entrepreneurial behaviours within universities, mould their entrepreneurial characteristics, and promote the engagement in ‘third’ mission activities within the organisations (Clark 1998; Guerrero and Urbano 2012; Thursby and Thursby 2002). These developments are particularly evident in the conceptualisation of the ‘entrepreneurial university’, which has risen to the fore in the literature explaining the associated structures that have emerged within universities in order to engage in their changing missions (Centobelli et al. 2019; Fini et al. 2018; Sharifi, Liu, and Ismail 2014).

At a meso level, the literature on U–I collaboration draws on insights from both the innovation systems and geography of innovation literatures. This focuses on the spatial dimension of U–I links, highlighting the roles of universities in the economic development process at a sub-national level, that is, the city and region (Huggins and Kitagawa 2012; Johnston and Huggins

2016; Pugh et al. 2016; Sanchez-Barrioluengo and Benneworth 2019; Uyarra 2010). As such, these insights are useful firstly for understanding the effect of a university's activities on its locale, and are formalised in the 'Triple Helix' Model of economic development, explicitly placing the university and its interaction with both industry and government at the heart of this process (Etzkowitz 2003a; Etzkowitz and Leydesdorff 2000; Ranga and Etzkowitz 2013). Secondly, this literature provides insights into the role of the physical distance between actors in the formation of U–I links (D'Este, Guy, and Iammarino 2013; D'Este and Iammarino 2010; Johnston and Huggins 2017).

While macro- and meso-level conceptual frameworks underpin the literature, it is work at the micro level that provides the greatest insights into SME–university collaboration. At this level, the focus is on the socio-technical nature of these collaborative links and draws heavily on the network and innovation alliances literature (Gulati 1999; Khanna, Gulati, and Nohria 1998). Therefore, the ability of actors to connect to one another is an important factor. Accordingly, both social capital and network capital are crucial to the formation of these links; with the former playing a role in breaking down barriers between actors from academia and industry (Al-Tabbaa and Ankrah 2016), and the latter promoting calculative network formation, ensuring that a tie will actually yield external knowledge for the firm to utilise in its innovation activities (Huggins 2010; Huggins and Johnston 2010; Huggins, Johnston, and Thompson 2012; Huggins, Prokop, and Thompson 2020).

Further insights from the innovation networks literature illuminate the importance of the similarities of collaborating actors and the social nature of these collaborative links (Gertner, Roberts, and Charles 2011; Knoblen and Oerlemans 2006). These similarities are conceptualised in terms of proximities that capture the closeness of actors across several dimensions including location (spatial proximity), network membership (social proximity), cognitive understanding (technological proximity), and similarity or working culture (organisational proximity) (Aguilera, Lethiais, and Rallet 2012). Therefore, in the context of SME–university collaboration, these relational and cognitive factors are important for allowing actors to connect with and understand one another (Al-Tabbaa and Ankrah 2016, 2019).

Through a detailed examination of SME–university collaboration, the analysis presented in this book presents several new findings regarding the understanding of U–I collaboration from the perspective of SMEs. To summarise, the analysis suggests that:

- Relational and cognitive factors are important for both the formation and function of collaborative links between SMEs and universities.
- Spatial proximity plays an implicit role in the collaboration process between SMEs and universities.

- The closeness of the actors in terms of social, technological, and organisational proximity may evolve through the collaboration process.
- A broad range of outputs and outcomes underpin the success of the project.
- Successful projects are more likely to result in enduring relationships between SMEs and universities.
- Collaborative projects between SMEs and universities are path dependent in nature, with prior experience of working with universities likely to result in more successful projects.

1.3 EMPIRICAL APPROACH OF THE BOOK

Given the fact that SMEs are under-represented in terms of the study of U–I collaboration (Laursen and Salter 2004; Mohnen and Hoareau 2003), examining their interactions in greater depth may shed more light on the motivations, processes, and means by which they develop U–I links to better inform both theory and policy. In order to complete this objective, this book adopts a realist approach to present a case study focused on the socio-technical characteristics of SMEs that engaged in formal collaborative projects with universities (Bhaskar 2008; Easton 2010). Essentially this allows for an objective ontology that treats constructs as observable and independent of the observer, while concurrently allowing for a subjective interpretation of those objects. As such, the approach of this book echoes the move away from what has been termed formalist approaches to the study of economic phenomena, underpinned by utility maximisation and rational choices, towards a ‘substantivist’ position based around reciprocity and redistribution (Polanyi 2001). In essence, this negates the Utilitarian tradition (Granovetter 1985), whereby an idealised picture of the process is painted.

Taking a realist position in the understanding of U–I collaboration allows the empirical work to reflect the actualities of this interaction, namely, the absence of a formal market for university knowledge and the associated mechanisms through which it may be coordinated, that is, a price system. This means that the development of U–I collaboration is more akin to archaic systems based on mutual exchange and embeddedness. As such, it cannot necessarily be described as a market process.

As collaboration between universities and industry is a complex process, reducing this complexity to what Granovetter (1985) describes as ‘thought experiments’ may only provide an incomplete assessment of the activities of which it is comprised. Importantly, given the increasing recognition that the process of U–I collaboration is a socio-technical process (Al-Tabbaa and Ankrah 2019), this approach allows the social dimension to be explicitly considered and evaluated.

This does not suggest the primacy of a qualitative approach; it merely asserts that in seeking to explore the phenomenon of U–I collaboration in sufficient depth, this approach lends itself to uncovering the processes that underpin this interaction. Indeed, the conceptual framework draws on a wealth of quantitative studies that provide many important insights. As such, the aim is to complement the extant empirical work in the field. Therefore, in order to explore the phenomenon of university collaboration from the perspective of the SMEs involved, the book draws on material from 22 in-depth semi-structured interviews with owners/managers of SMEs, defined according to accepted conventions as those with fewer than 250 employees. The sample of firms employed between three and 120 workers, with average employment around 26, thus the book captures the experience of the small firm in this process.

The participating SMEs had mostly collaborated with universities through the Knowledge Transfer Partnership (KTP) programme. KTPs are designed to assist UK business with innovation and, by extension, also promote their growth. The aim of the programme is to promote collaboration between firms and universities, ensuring that the ‘latest academic thinking’ is introduced into the firm to promote innovation. These projects can last between one and three years and are part-funded by a public grant to cover the costs of the project. Consequently, an SME contributes around one-third of the costs (up to £35,000, but generally lower). In addition, the project employs a graduate with specialist knowledge of the field, referred to as the Associate, to work full time on the project at the premises of the firm.

In order to examine as broad a range of projects as possible so that a wide range of experiences of U–I interaction could be captured, no *a priori* restrictions were placed on the types of firms included; consequently, the case study features firms that operate in a diverse range of sectors such as biotechnology, engineering, finance, and digital marketing. Furthermore, the participating SMEs worked with a broad cross-section of UK universities.

To capture experiences of the respondents, the analysis utilises a narrative approach, influenced by the increasing use of these techniques in both the organisation studies (Boje 2001; Czarniawska 1998) and entrepreneurship literatures (Discua Cruz, Hamilton, and Jack 2020; Gartner 2010). This enables the key events occurring during these collaborative partnerships to be identified and allows an interpretation of the participants’ perceptions of these events to be captured from their perspective. Accordingly, the semi-structured interviews, based around a loose script, enabled the use of a quasi-‘life-story approach’ to be used (Johansson 2004). This allows the participants to discuss events from their point of view rather than based on a pre-defined set of factors (Clandinin and Connelly 2000). Naturally, each respondent differed in their openness to the interviewer; some were happy to talk at length about

the project and needed just minimal prompting. When respondents were less forthcoming, the interviewers relied more upon developing focused-interview narratives (Mishler 1986), that is, building the narratives through the probing of respondents enabling greater details of their specific projects to be captured. In line with the overall approach, this probing was accomplished while following the rules of not interrupting and letting the respondent outline the events.

Adhering to these methodological protocols ensured that the respondents were given a voice (Bauer 1996), enabling the creation of a ‘multi-voiced’ account from the perspective of SMEs and the process of developing an idea for a new project, the pursuit of a university collaboration to realise the projects’ outcome, undertaking the project, and the projects (Ericson 2010; Fletcher 2007). Thus, while narrative approaches may be broad in scope (Larty and Hamilton 2011), the approach utilised in this book has created a set of first person descriptions of events surrounding the experiences of participating in collaborative projects with universities from those involved. The narratives are, therefore, designed to provide the story – hence the empirical chapters present quotes in order to provide the participants with a voice, and enable their words to tell the story.

Using this approach means that the analysis is concerned with connecting the individual stories into a plot in order to highlight the activities that occur within the firms (Steyaert 2007). Consequently, the analysis utilises what have been described as structuralist approaches to analysing narrative (Larty and Hamilton 2011).

1.4 STRUCTURE OF THE BOOK

The first half of the book presents a state-of-the-art literature review of university engagement among firms. Chapters 2–4 provide a comprehensive overview of the conceptual underpinnings of this literature as well as the key empirical findings. As inter-organisational collaborative partnerships have been conceptualised as a four-stage socio-technical process, this provides a structure for the empirical chapters of this book: (1) identifying needs; (2) assessing and selecting a partner; (3) implementing a partnership; and (4) reassessing the partnership (Kim et al. 2010), which further provides a guiding framework for presenting the analysis. Chapter 5 examines the policy development underpinning the promotion of U–I collaboration in the UK and examines recent patterns of engagement using publicly available data. Chapter 6 explores the process of project creation and identifying the need to procure external resources within the small firm. Chapter 7 then examines the partner selection process of SMEs when they develop the collaborative links with universities. Chapter 8 examines the dynamics of the partnership

and the usefulness of the knowledge obtained from the SMEs' university partner. Chapter 9 analyses the end of the project and the relative success of the partnership. Finally, Chapter 10 summarises the findings, their contribution to the overall understanding of SME–university collaboration, and discusses their implications for SMEs, academics, knowledge exchange practitioners, and policymakers.