

# State of the Art Review



## University-Industry Collaboration: Are SMEs Different?



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There is significant interest in university-industry collaboration among both academics and policymakers. These collaborative links are regarded as an important mechanism for the pursuit of R&D activities within an economy and encouraging innovation among firms. Due to their relative resource constraints, SMEs potentially stand to benefit from these collaborations as a means for leveraging new knowledge and expertise into the firm. However, perceptions of non-engagement with universities among SMEs are commonplace within the academic literature. In order to investigate this in more detail, this review examines the impact of firm size on university-industry collaborations to assess whether SMEs are in fact distinct. The findings suggest that while SMEs do collaborate with universities, they are subject to differing dynamics as firm size has a significant impact on type of collaboration, the outcomes, perception of barriers, and reliance on local universities.

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## Background

As the innovation process has come to be regarded as more open in nature, universities in turn are viewed as important components of these systems. Consequently, collaborative links between universities and firms is viewed as an important means through which innovation is accomplished within an economy (Etzkowitz 2003; Etzkowitz and Leydesdorff 2000; Mansfield 1995). Accordingly, policy makers worldwide have encouraged the formation of these links (European Commission 2011; HM Government 2017; OECD 2007; Sainsbury 2007; Wilson 2012).

The literature on university-Industry (U-I) links is well developed and provides a broad examination of the phenomenon, covering several countries, including UK, USA, China, South Korea, Italy, Germany, Japan, Chile, and Sweden, as well as a range of industrial sectors including manufacturing, food and drink, knowledge intensive business services, and biotechnology. The evidence presented in this review focuses on studies of university collaboration that utilised large datasets comprised of a range of firms. Crucially, these studies included a firm size variable (i.e. number of

employees) which allows us to assess the influence of this on U-I collaborations, and therefore the likely implications for SMEs.

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## Summary of the evidence

The key insight from the university collaboration literature is that smaller firms are less likely to develop collaborative links with universities than their larger counterparts (Belderbos et al. 2004; Bodas Freitas, Geuna, and Rossi 2013; Cohen, Nelson, and Walsh 2002; Fontana, Geuna, and Matt 2006; Laursen, Reichstein, and Salter 2011; Laursen and Salter 2004; Levy, Roux, and Wolff 2009; Mohnen and Hoareau 2003; Motohashi 2005). According to Fontana et al (2006), this size effect is 'absolute' in nature, i.e. the result of the total number of employees within the firm not just those undertaking R&D activities. Therefore, these findings appear to confirm evidence from the broader innovation literature which suggests that, overall, SMES have a lower propensity to engage in external knowledge networks (Autant-Bernard et al. 2007; Tether 2002). Furthermore, in a UK context, SMEs have also been found to rate universities as less important sources of knowledge than other actors such as their customers and suppliers (Freel and Harrison 2006; Hughes and Kitson 2012; Andrew Johnston and Prokop 2019) adding to a perception of non-engagement.

However, the available evidence does not conclude that SMEs do not engage with universities, only that vis a vis larger firms, it is the latter that are more prone to developing these collaborative links. Indeed, a careful reading of the literature reveals several interesting insights and reveals a relationship that is more nuanced than simply stating larger firms are more likely to collaborate with universities than SMEs. For example, while larger firms may be more likely to collaborate with a university, SMEs tend to engage in a higher number of projects (Motohashi 2005). Additionally, Bodas-Freitas et al. (2013) surveyed manufacturing firms in Italy and found that larger firms are more likely to be engaged in formal interaction with universities. Thus, SMEs may be engaging in less formal activities, with firm size influencing the type of collaboration that occurs rather than if it occurs at all. Indeed, as university collaboration covers a range of activities, formal and informal (Perkmann et al. 2013), SME interaction may be under-recorded as it is less formal in nature. As well as the level of formality of the collaboration, other evidence suggests that firm size influences the nature of the project, with larger firms more focussed on short term projects centred on rapid organisational learning (Broström 2010).

Firm size has also been found to influence the impacts of university collaboration. Firstly, smaller firms are less likely to develop patents from university collaborations (Baba, Shichijo, and Sedita 2009; Eom and Lee 2010). In conjunction, further evidence suggests that as firm size positively influences uniqueness of the outputs developed in the course of a university collaboration (Wirsich et al. 2016), SMEs are less likely to be developing cutting edge outputs. Therefore, for SMEs, U-I collaboration is less likely to result in outputs that are both new to the market and, therefore, patentable.

When patents are developed from U-I collaborations, no variations in terms of their quality between SMEs and larger firms have been observed (Soh and Subramanian 2014). However, the patents developed by SMEs through university collaborations tend to receive fewer forward citations (Dornbusch and Neuhäusler 2015). Furthermore, the relationship between firm size and patenting from university collaboration may be non-linear, with a firm size of 171 employees suggested as the optimum (Fukugawa 2013). Consequently, as such a firm would be classed as medium

sized, the SME may in fact be the optimum organisational form for developing novel outputs from university collaboration.

In contrast, other benefits from engaging with a university, such as improving understanding, gaining knowledge, problem solving, and training the workforce appear to be unrelated to firm size (Bishop, D'Este, and Neely 2011). The only area where significant differences related to firm size were observed was in recruitment of university postgraduates, where which was positively linked to firm size (ibid).

In terms of barriers to engagement with universities, Bruneel et al. (2010) found that SMEs were less likely to perceive the existence of barriers caused by legal or contractual issues. Conversely, no differences were observed between SMEs and larger firms with respect to barriers associated with differences in objectives of the project and working practices between the partners (Bruneel, D'Este, and Salter 2010). Thus, SMEs are no more likely to perceive barriers associated with differing working practices within academia and industry, the so-called 'two-worlds paradox' that suggests the two sectors are incompatible (Hewitt-Dundas, Gkypali, and Roper 2019). The importance of the spatial proximity, or physical closeness, of the partners also varies according to firm size; with evidence from the UK Knowledge Intensive Business Services (KIBS) sector suggesting that the distinction is not between SMEs and large firms, but micro firms and other firms (Johnston and Huggins 2017). Thus, it is only the very smallest firms that are more likely to rely on partners located close by. This is corroborated for the general firm population of the UK, where larger firms were found to be less likely to collaborate with local universities (Hewitt-Dundas 2011).

Conversely, there are also studies which report the fact that firm size is not a significant determinant of U-I collaboration (Eom and Lee 2010), or that firm size has a negative effect on the propensity to engage with universities (Hewitt-Dundas 2011), suggesting SMEs are no less or even more likely to collaborate in this way. Additionally, there is evidence that it is only the very smallest firms are less likely engage in U-I collaboration, micro firms rather than SMEs (Maietta 2015). Finally, context may also be important as Guiliani and Arza's (2008) study of wine producing firms in Italy and Chile found that in Chile larger firms were more likely to partner with a university, whereas in Italy smaller firms were more likely.

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## Summary and evidence gaps

In summary, firm size can influence the propensity to collaborate with universities but merely focussing on this headline finding masks a myriad of variations in the collaborations and their outcomes according to firm size. These include:

- SMEs are less likely to engage in formal collaborations.
- SMEs more likely to undertake a higher number of collaborations.
- The outcomes of university collaboration may vary according to firm size, with SMEs less likely to patent the outcome (and where they do, they are less likely to be cited in the development of a new patent) or recruit new employees through U-I interaction.
- SMEs may perceive fewer barriers to U-I collaboration.
- SMEs tend to rely on partnering with local universities.

These findings suggest several gaps in the evidence that require addressing in order to develop a more complete understanding of SME-university collaboration. First, is university collaboration a linear relationship with firm size? Is there an optimum firm size for U-I collaboration? Second, is firm size in terms of employees a good measure of 'size', or would turnover or productivity better capture firm differences? Third, is the age of an SME important? Fourth, the extant literature is mostly focussed on developed countries, thus empirical studies of developing economies to examine context would provide more evidence. Fifth, more evidence is required as to the types of university collaboration an SME engages in to prevent under-recording of the phenomenon. Finally, should we treat SMEs as a homogenous entity? Collecting more evidence that captures variations in university collaborations in terms of sectors, age, and location would provide a richer understanding of how they vary in their engagement with universities and allow policymakers and technology transfer officers to develop effective strategies to encourage SMEs to collaborate with universities.

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