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University Spin-Offs: Entrepreneurship, Growth and Regional Development

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Abstract

Over the past years, the role of universities has been faced with important changes that led to substantial attention from both researchers and policy-makers to their third mission, labelled “a contribution to society”, besides the teaching and research missions. University spin-offs (USOs or ASOs, for Academic spin-offs), emerged among the potential means for universities to pursue the third mission. Research on the creation, emergence, development and scaling up of USOs has grown significantly with contributions from multiple subject areas. This special issue contributes to the research debate by presenting novel insights that deepen and enhance our understanding of the dynamics surrounding the entrepreneurial aspects of academic spin-offs, their growth and their mutual relationship with regional development. The special issue provides rigorous qualitative, quantitative and theoretical investigations to form a research agenda which will help guide future research efforts.

Keywords: University Spin-offs; Academic Spin-offs; Third Mission; Universities; Entrepreneurship; Growth; Regional Development

1. Introduction

Over the last decades, there has been a multiplication of studies concerning the so-called third mission of universities (Compagnucci and Spigarelli, 2020), now being called to contribute directly to economic development through collaboration with industry and exploitation of research results (e.g., Miller et al., 2016; Rossi, 2010). Among the potential means for universities to pursue this mission, the phenomenon of university spin-offs has attracted a steady increase in attention by research and practice (Mathisen and Rasmussen, 2019), even though it may be viewed as a rather specialist niche in entrepreneurship studies.

There are a number of attractions to the study of spin-offs though, not least the rather iconic role of such examples in the emergence of some new science-based industries. It is also a highly policy-driven topic as governments seek some payback for their investment in university science through commercialisation, with spin-offs as a highly visible aspect. Policymakers around the world anticipate the possibility of new technology-based firms emerging from universities and have made changes to intellectual property regulations and to the support for academic entrepreneurship in recent decades (Mowery, 2005). Encouraged by a few high-profile examples, particularly from the US, there is a hope that universities may stimulate local and national economies through the next growth industry. Few universities or regions see significant successes though, despite the optimism of policymakers, yet spin-offs still attract research interest. This special issue brings together a number of papers examining spin-offs from different perspectives. As an introduction to the issue, some general trends in the literature are identified as a means of framing the specific issues that are presented in the attached research papers.

2. The study of University Spin-Offs

USOs are of great interest to policymakers and researchers alike because of assumptions about their contributions to the exploitation of academic knowledge and their impact on regional economies. The impact on knowledge commercialisation is a central concern of both governments and universities as the commercial potential of new academic discoveries and the growing need for universities to find new sources of revenue push universities to seek effective means of exploitation of knowledge (Clark, 1998; Shane, 2004; Etzkowitz, 2013). The spin-off is seen as an attractive option compared with patent licensing (Siegel and Wright, 2015) and governments have been keen to ensure that the exploitation of university knowledge has an impact on the domestic economy, more likely for a spin-off than for a license.

Spin-off companies tend to locate close to their source institutions and become valuable agents for local economic development and economies of agglomeration (e.g., Benneworth and Charles, 2005; Hakala, 2009). Spin-offs also create jobs for highly skilled graduates and show strong economic effects for the regional community (Abramo and D'Angelo, 2014; Rothaermel and Thursby, 2005), providing valuable knowledge spillover for other companies (Benneworth and Charles, 2005). The belief in the importance of university spin-offs (USOs) for economic development explains the increasing diffusion of government actions aimed at fostering this form of entrepreneurship in various countries, as well as the publication of studies seeking to better understand and address the drivers that shape spin-off activity in higher education institutions (Di Gregorio and Shane, 2003; O'Shea et al., 2008; Wright et al., 2006).

The point about the relative fixity of location of spin-offs retaining the impact of exploitation to the local economy also fuels the policy interest at the local level as regional policymakers see the potential of USOs as drivers of change in the local economy. Studies of high-performance regions with burgeoning tech clusters, often with successful USOs, create an aspiration for other regions to see USOs as a route to economic regeneration. Whilst cases of high-growth USOs are limited in number and often presented anecdotally, there are often expectations of employment growth, the emergence of new clusters, wider economic impacts and demonstration effects on local businesses and institutions (Benneworth and Charles, 2005).

Although reaching satisfactory performance is a necessary condition to guarantee a positive impact of research spin-offs on local economies, literature on USOs has primarily focused on the factors affecting spin-off foundation (Abramo and D'Angelo, 2014; Grimaldi et al., 2011; Muscio et al., 2016), and empirical research identifying the drivers of the growth and long-term survival of university spin-offs are scarce (Walter et al., 2006). Indeed, only a few studies have recently started to investigate the ability of USOs to generate first revenues, survive in the long term and grow (Scholten et al., 2015; Slavtchev and Göktepe-Hultén, 2016). This last issue is of particular interest considering that academic spin-offs are often very small firms, often without an effective business model (Colombo et al., 2010) and with a very low survival rate (Chiesa and Piccaluga, 2000).

The evidence of success is however limited as many USOs remain small, lifestyle businesses, or even zombies, living dead (Ruhnka et al 1994) or twilight USOs. Such living dead USOs may be kept alive by their parent universities in the hope of a trade sale for the value of their IP, even though they are not themselves trading. The poor performance of USOs leads to some claims that they do not justify the state support they often receive (Harrison and Leitch 2010; Wright et al. 2007). For some, attention should be shifted away from USOs as academic-led ventures to commercialise university technology in favour of a focus on graduate start-ups emerging from entrepreneurship initiatives embedded within degree programmes.

It may not be too surprising that academic researchers also look to spin-offs as a core element of their research on entrepreneurship. Perhaps one reason for the popularity of studies on USOs is the relatively good access to data. In several countries, there are annual surveys of university commercialisation activities which can be used to identify the number and some measures of USOs by the university which can then be related to characteristics of the host university. In the UK the HEBCI survey (Higher Education Business and Community Interaction) has been used in a number of studies (eg Barrioluengo et al 2019). Universities are also a relatively approachable source for more qualitative data about USOs.

A large part of the extant literature considers the ability to combine academic, entrepreneurial and managerial presence as a key driver for the USOs success (Abramo et al., 2012; Colombo et al., 2010). USOs are indeed archetypical cases of companies requiring an effective management of the intersection of academic research and industry (Pirnay and Surlemont, 2003; Rossi, 2010) in order to be successful. These companies are set up to market inventions or scientific discoveries carried out within the university labs, by the means of finding appropriate applications or even building entire markets ex novo. This goal requires the implementation of a number of activities specifically aimed at the integration of technological features and business strategy: technology impact on processes and/or products, market analysis, the definition of the appropriate business model, creation of networks of stakeholders, adoption of efficient processes and routines (Linton and Walsh, 2008; Tolstoy and Agndal, 2010).

Clusters have been described as having a 'discrete charm of obscure objects of desire' (Steiner, 1998), but this could easily be claimed for spin-offs also. A successful USO in the form of a rapidly growing technology business, especially in a region which is economically lagging is a highly desirable object for both the university and the region and local policymakers. On the one side, only the growth and the survival of spin-off companies can improve their regional economies and innovation environments through knowledge accumulation (Benneworth and Charles, 2005). On the other side, University and local contexts can play a key role in supporting the creation and the growth of academic spin-offs such as legislative support, amount of social capital, financial development, presence of business incubators, public R&D expenses (Colombo et al., 2010; Rossi, 2010; Wright et al., 2006). Yet there is obscurity around how such successful USOs can be created, whether they are feasible in regions with weak entrepreneurial ecosystems, or whether successful universities and entrepreneurship policies can overcome traditional regional weaknesses to establish new growth potentials. These questions are at the heart of much of the literature on USOs and remain largely unclear as the high levels of uncertainty around individual USO projects, and variability in context are important elements in such analysis (Fini et al., 2011). Consequently, there is a need for further investigation of the factors influencing the real performance of academic spin-offs and the resulting implications on local economies and regional development (Rasmussen et al., 2015; Wennberg et al., 2011).

3. Articles within this special issue

The aim of this Special Issue was to assemble novel and rigorous papers that deepen and enhance understanding of academic spin-offs growth and their mutual relationship with regional development. We sought both empirical (qualitative and quantitative) and conceptual papers in order to enhance knowledge and allow for theory development. The eight papers selected explore varying aspects of University Spin-offs from different angles and levels of analysis. We aimed to bring together studies that investigated the individual characteristics (micro), the organisational dynamics (meso), and the regional and systemic impacts (macro).

The first paper, titled “University Spin-Offs: The past, the present, and the future” by Dabić, Vlačić, Guerrero and Daim opens up the special issue by providing an overview of the field of study. A number of research questions are raised following a review of 35 years of literature on university spin-offs in a systematic literature review. They reinforce the view of increasing interest in the topic by observing a massive increase in publications since 2013. There may be numerous reasons contributing to this rise, but it is clear the topic remains a major concern of academics and policymakers. Using multiple correspondence analysis, Dabić et al map out the main themes of the literature, between ‘orchestration and innovation’ and the ‘quadruple helix perspective’ on one axis, and between ‘entrepreneurial culture and performance’ and ‘risk and uncertainty’ on the other. They identify the need for more work of an interdisciplinary nature, addressing question such as dynamic configurations of governance and organisational composition, sharing of risks and resources, scaling up and the relationship between the USO and the ecosystem.

The second paper by Caputo, Pellegrini and Nikiforou, titled “Entrepreneurial Decision-Making in Academic Spin-offs: A Bibliometric Map and Research Agenda” opens a section of the special issue that collates studies looking at the individual characteristics and dynamics within University Spin-offs (i.e. the micro level), where three papers examine some of the internal characteristics of the USOs, examining decision-making, team heterogeneity, and the conditions of trust between the USO and university. The paper provides an overview of the field of studies that investigated the decision-making of academic entrepreneurs and relevant stakeholders. The authors develop a research agenda following the bibliometric analysis and systematic literature review of 60 papers published during the period 2003-2021. Four areas of studies are identified: contextual factors, spin-off development and performance, nascent academic entrepreneurship, and science parks. The systematisation of the research on the decision-making processes and dynamics within University Spin-offs is of paramount importance to support the effort of scholars and policy-makers in understanding what drives the creation of (more) academic spin-offs that have good chances of surviving and thriving. The authors provide their overview and research agenda by benchmarking the findings from the identified macro areas with the highly influential framework on entrepreneurial decision-making of Shepherd et al. (2015), and propose future research directions in light of the unique characteristics of academic entrepreneurs and academic spin-offs.

Next, Fiorentino, Parmentola, Sapio and Capurro further the investigation of the micro level with their paper “Entrepreneurial team heterogeneity and performance of academic spin-offs: a pre and post foundation analysis”. Looking at Italian USOs, their research focuses on the internal factors driving University Spin-offs, analysing the effect of the heterogeneity of entrepreneurial teams on the performance of ASOs from a longitudinal perspective. The paper aims to inform public authorities from managers to policy-makers who seek to encourage the benefits of the university’s Third Mission and its role in economic growth. They investigate how ASO entrepreneurial team heterogeneity, both horizontal (cognitive) and vertical (status), and changes in entrepreneurial team heterogeneity between the pre-foundation and post-foundation stages affect ASO performance. Findings show that vertical heterogeneity in the composition of the pre-foundation team is a driver of ASO performance in the short term and more so if the average seniority of academics is low. Horizontal heterogeneity plays a negative moderating role. However, longer-term performance is more influenced by horizontal heterogeneity, implying slower growth after the spin-off foundation.

The paper “Trust- and Distrust-Building Mechanisms in Academic Spin-Off Relationships with a Parent University”, authored by Czakon, Jedynakb and Konopka-Cupiałc focuses on trust and distrust in the relationship between the spin-off and the parent university. Trust is a neglected issue in the study of spin-offs. From a behavioural perspective, the authors argue that these relationships are

consequential to the behaviour of University Spin-off entrepreneurs, their attention focus and their business development. University and USO cultures differ, which may create tensions. Yet, these tensions may be alleviated by effective governance, and trust in particular. The interplay between trust and distrust appears as asymmetrical and ambivalent. They identify the mechanisms that lead to trust and to distrust at the individual and institutional levels. The findings contribute to better understanding of the behavioural underpinnings of effective USO-parent university relationships.

Moving to the organisational – meso – level of investigation, Messina, Miller, Cunningham, McAdam and Hewitt-Dundas explore the issue of internationalisation of USOs with their work titled “Exploring the influence of innovativeness on the pace of internationalisation of University Spin-Outs: A Born Global Perspective”. Their work aims to fill a research gap in both USO literature and international business, that of the under-researched area of the specific characteristics of core technology, in particular innovativeness, as a determinant of early internationalisation. The authors looked at how innovativeness is nurtured and cumulatively developed during born-global and non-born-global USOs’ pre-foundation technology development trajectory. Their findings show that born-global USOs had a longer pre-foundation period, focused on a specific invention with limited fields of application, and offered new innovations. In contrast, non-born-global USOs were characterised by short pre-foundation periods, relied on incremental innovation and a wide spectrum of innovative competencies.

Next, Messeni Petruzzelli and Murgia, with a paper titled “The regional impact of spin-offs’ innovative activity: Unveiling the effect of scientific knowledge and parent university’s specialization”, move the attention of the special issue toward the potential role of university spin-offs (USOs) as drivers of regional development by investigating German and Italian USOs. Specifically, USOs may support regional development by exploiting the scientific knowledge developed by their parent universities into industrial innovations, thus spreading knowledge spillovers that can be in turn exploited by other local firms. In their paper, they analyse how the use of these spillovers at the regional level may depend on the USOs’ capabilities to implement scientific knowledge into their innovation development as well as to align this knowledge to the needs of local organizations. They provide a discussion about how these capabilities may be more easily developed by USOs of generalist universities that focus their scientific effort on a broader range of scientific domains and tend to establish stronger relationships with local firms. Their findings show that both a larger use of scientific knowledge and a higher generality of the parent university increase the regional impact of the USOs’ inventions. Their findings may shed further light on the actual contribution of USOs to regional development, by providing a better understanding of their role in the transfer of scientific knowledge.

A related question is that investigated by Prokop and Kitagawa in their work titled “Shareholder Networks of University Spin-off Companies: Firm Development and Regional Characteristics”. Looking at the UK, the paper contributes to the study of University Spin-off development by analysing the structural properties of their shareholder networks over time and across different regions. The study utilises a large sample of 1033 academic spin-offs founded by 87 universities across 12 unitary regions in the UK. The findings identify three key phases of USO development: organisation phase, exploitation phase, and maturity and reorganisation phase. Furthermore, they observe differences in USOs in terms of shareholder network development across diverse regional contexts and propose a novel typology of entrepreneurial regions to better understand the diverse spatiality of USOs: peripheral lock-in, entrepreneurial periphery, rigid core, and entrepreneurial core.

The last paper of the special issue, by Jelfs and Lawton Smith, titled “A Comparative Study of the Survival of University Spin-Off Companies (USOs) in the post-industrial UK West Midlands region” concludes the journey around the issues related to the extent to which the spin-off is seen as an appropriate route for the commercialisation of university intellectual property, and hence a central element of the entrepreneurial university model. The authors consider the survival rates of USOs in UK regions relative to a series of previous studies. Whilst survival rates appear to be higher than that of other companies (Shane, 2004), there is a lack of consistent methods of estimating survival rates, leading to problems of comparison within and between countries.

4. Concluding points

The papers in this special issue address a number of key challenges for the study of USOs and delve into some of the details of the emergence and contribution of USOs. They do however also raise a number of generic questions which should be addressed in future studies.

First there is the consideration of the mission and role of the university in supporting spin off activity. The entrepreneurial university remains a popular framework for the consideration of a university's contribution to the local economy and indeed for the conceptualisation of the university's third mission, and USOs are a key element is that theorisation of the university mission. There is however a debate between this and the engaged or civic university paradigm, which focuses more on the wider social contribution of the university rather than primarily the entrepreneurial impact. Is entrepreneurship the most important focus for government investment in the portfolio of university activity when compared with other types of intervention? Does the emphasis on metrics relating to commercialisation and USOs tend to overshadow other university engagement activities?

Emerging from this a critical question for USO researchers is whether the regional benefits resulting from USOs outweigh the levels of investment by governments and universities. There have been concerns in some quarters that policymakers have prioritised the numbers of spin-offs rather than the quality or outcomes (Harrison and Leitch, 2010) with the result that universities have been incentivised to create USOs that are not always viable and may linger on as the living dead. In the UK for example the funding formula for the third mission core grant includes a measure of new firms founded, but then this is easier to measure than the longer term success of such firms. Greater emphasis perhaps needs to be placed on the long term outcomes and impacts of USO formation rather than just on the act of formation in itself.

One of the problems of measuring USOs is shown by Jelfs and Lawton Smith in that they focus on USOs in which the parent university held an equity stake in trying to identify the number of starts and failures. Whilst this offers a consistent definition of a USO, it neglects a range of other forms of firm established on the basis of university expertise, or drawing on university-based founders. The core phenomenon we should be concerned with is that the presence of a university leads to new businesses which draw some benefit from the staff and knowledge of the university. In recent years this has often meant USOs with university holding equity in the firm, but this is only because universities have become stricter on the protection of IP developed by university staff, and have adopted a policy of using that IP to take equity in USOs. Previously, and still in some countries, the IP was often protected by the individual, and universities did not have a policy of taking equity stakes. Some were concerned that equity implied some legal liability and eschewed it. Even now many companies established by academics may be based on expertise rather than IP, focused on consultancy rather than product development, and hence without IP there is no legal basis on which universities can expect equity stakes. Many successful USOs have been formed by academics simply leaving the university and setting up a new business with no direct connection back to the university.

In this case there is a potential loss of revenue to the university, but commercialisation of university expertise still takes place and any economic impacts still accrue to the region. The definition of a USO as one where the university retains equity prioritises a particular institutional policy, over cases where perhaps the university decides not to take equity but takes a license or where the spin-off is based on expertise rather than formal IP. This has implications in that studies at different points in time may give different results as university policies on IP and equity change, so levels of formation may be inflated by the change of policy as more USOs are compliant with the definition. Would a broader perspective on university-related start-ups also demonstrate greater regional benefits?

These papers also raise legitimate questions about whether we can expect similar levels of USO formation and evolution in regions with different entrepreneurial potential and ecosystem infrastructure. To what extent is the level of formation a function just of the quality of research and commercialisation support within the university, or is it also influenced by the wider regional ecosystem? A good university in a lagging region may initiate a lot of positive ideas for USOs but will it have the same positive experiences as a similar university in a strong region? A counterargument is that by developing USOs and creating a supportive infrastructure, the university may have an impact on the ecosystem, so the benefits of USOs are not restricted to the USOs themselves but to the support for other technology-based firms in the wider region. The resolution of this issue depends on the nature of support offered, whether it is recognised that USOs in peripheral regions need greater support, and if that support has impacts beyond the university.

These questions and more may be expected to stimulate further research on this topic, building on the work in this special issue. From the micro-level study of USOs and their management and IP strategies to the organisational approach of universities and the regional ecosystems and context, the papers here identify the complexity of the act of establishing a university spinoff, and then assessing its impact. Ultimately though the aim is to ensure that universities and governments are making effective decisions in deciding to allocate resources and design effective policies to promote spin offs.

References

- Abramo, G. and D'Angelo, C.A. (2014), "The spin-off of elite universities in non-competitive, undifferentiated higher education systems: an empirical simulation in Italy", *Studies in Higher Education*, Routledge, Vol. 39 No. 7, pp. 1270–1289.
- Abramo, G., D'Angelo, C.A., Ferretti, M. and Parmentola, A. (2012), "An individual-level assessment of the relationship between spin-off activities and research performance in universities", *R&D Management*, Wiley Online Library, Vol. 42 No. 3, pp. 225–242.
- Barrioluengo, MS, Uyarra, E & Kitagawa, F 2019, 'Understanding the evolution of the entrepreneurial university: The case of English Higher Education', *Higher Education Quarterly*, 73, 469-495.
- Benneworth, P. and Charles, D. (2005), "University spin-off policies and economic development in less successful regions: learning from two decades of policy practice", *European Planning Studies*, Taylor & Francis, Vol. 13 No. 4, pp. 537–557.
- Chiesa, V. and Piccaluga, A. (2000), "Exploitation and diffusion of public research: the case of academic spin-off companies in Italy", *R&D Management*, Wiley Online Library, Vol. 30 No. 4, pp. 329–340.
- Colombo, M.G., D'Adda, D. and Piva, E. (2010), "The contribution of university research to the growth of academic start-ups: an empirical analysis", *The Journal of Technology Transfer*, Springer, Vol. 35 No. 1, pp. 113–140.
- Compagnucci, L. and Spigarelli, F. (2020). The Third Mission of the university: A systematic literature review on potentials and constraints. *Technological Forecasting and Social Change*, 161, 120284.
- Di Gregorio, D. and Shane, S. (2003), "Why do some universities generate more start-ups than others?", *Research Policy*, Elsevier, Vol. 32 No. 2, pp. 209–227.
- Etzkowitz, H. (2013) Anatomy of the entrepreneurial university, *Social Science Information*, 52(3) 486–511.
- Fini, R., Grimaldi, R., Santoni, S. and Sobrero, M. (2011), "Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs", *Research Policy*, Elsevier, Vol. 40 No. 8, pp. 1113–1127.
- Hakala, J. (2009), "Socialization of junior researchers in new academic research environments: Two case studies from Finland", *Studies in Higher Education*, Routledge, Vol. 34 No. 5, pp. 501–516.
- Harrison, R and Leitch, C (2010) Voodoo Institution or Entrepreneurial University? Spin-off Companies, the Entrepreneurial System and Regional Development in the UK, *Regional Studies*, 44:9, 1241-1262
- Linton, J.D. and Walsh, S.T. (2008), "A theory of innovation for process-based innovations such as nanotechnology", *Technological Forecasting and Social Change*, Elsevier, Vol. 75 No. 5, pp. 583–594.
- Mathisen, M.T. and Rasmussen, E. (2019) The development, growth, and performance of university spin-offs: a critical review, *The Journal of Technology Transfer*, 44:1891–1938
- Miller, K., McAdam, R. and McAdam, M. (2016), "A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda", *R&D Management*, Wiley Online Library.

Mowery, D.C. (2005), "The Bayh-Dole Act and High-Technology Entrepreneurship in U.S. Universities: Chicken, Egg, or Something Else?", Libecap, G.D. (Ed.) *University Entrepreneurship and Technology Transfer (Advances in the Study of Entrepreneurship, Innovation and Economic Growth, Vol. 16)*, Emerald Group Publishing Limited, Bingley, pp. 39-68.

Muscio, A., Quaglione, D. and Ramaciotti, L. (2016), "The effects of university rules on spinoff creation: The case of academia in Italy", *Research Policy*, Elsevier, Vol. 45 No. 7, pp. 1386–1396.

O'Shea, R.P., Chugh, H. and Allen, T.J. (2008), "Determinants and consequences of university spinoff activity: a conceptual framework", *The Journal of Technology Transfer*, Springer, Vol. 33 No. 6, pp. 653–666.

Pirnay, F. and Surlemont, B. (2003), "Toward a typology of university spin-offs", *Small Business Economics*, Springer, Vol. 21 No. 4, pp. 355–369.

Rasmussen, E., Mosey, S. and Wright, M. (2015), "The transformation of network ties to develop entrepreneurial competencies for university spin-offs", *Entrepreneurship & Regional Development*, Taylor & Francis, Vol. 27 No. 7–8, pp. 430–457.

Rossi, F. (2010), "Massification, competition and organizational diversity in higher education: evidence from Italy", *Studies in Higher Education*, Taylor & Francis, Vol. 35 No. 3, pp. 277–300.

Rothaermel, F.T. and Thursby, M. (2005), "Incubator firm failure or graduation?: The role of university linkages", *Research Policy*, Elsevier, Vol. 34 No. 7, pp. 1076–1090.

Ruhnka, J., Feldman, H. and Dean, T. (1992). The "living dead" phenomenon in venture capital investments. *Journal of Business Venturing*, 7(2), 137-155.

Scholten, V., Omta, O., Kemp, R. and Elfring, T. (2015), "Bridging ties and the role of research and start-up experience on the early growth of Dutch academic spin-offs", *Technovation*, Elsevier, Vol. 45, pp. 40–51.

Shane, S. A. (2004). *Academic entrepreneurship: University spinoffs and wealth creation*. Massachusetts: Edward Elgar Publishing.

Shepherd, D. A., T. A. Williams, and Patzelt H. (2015), "Thinking about entrepreneurial decision making: Review and research agenda." *Journal of management* 41(1): 11-46.

Siegel, D S., and Wright, M (2015) 'University Technology Transfer Offices, Licensing, and Start-Ups', in Albert N. Link, Donald S. Siegel, and Mike Wright (eds), *The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship* (Chicago, IL, online edn, Chicago Scholarship Online, 17 Sept. 2015), <https://doi.org/10.7208/chicago/9780226178486.003.0001>.

Slavtchev, V. and Göktepe-Hultén, D. (2016), "Support for public research spin-offs by the parent organizations and the speed of commercialization", *The Journal of Technology Transfer*, Springer, Vol. 41 No. 6, pp. 1507–1525.

Steiner, M. (1998) (Ed.) *Clusters and Regional Specialisation: On Geography, Technology and Networks*, London: Pion.

Tolstoy, D. and Agndal, H. (2010), "Network resource combinations in the international venturing of small biotech firms", *Technovation*, Elsevier, Vol. 30 No. 1, pp. 24–36.

Walter, A., Auer, M. and Ritter, T. (2006), "The impact of network capabilities and entrepreneurial orientation on university spin-off performance", *Journal of Business Venturing*, Elsevier, Vol. 21 No. 4, pp. 541–567.

Wennberg, K., Wiklund, J. and Wright, M. (2011), "The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs", *Research Policy*, Elsevier, Vol. 40 No. 8, pp. 1128–1143.

Wright, M., Lockett, A., Clarysse, B. and Binks, M. (2006), "University spin-out companies and venture capital", *Research Policy*, Elsevier, Vol. 35 No. 4, pp. 481–501.

Wright, M., Clarysse, B., Mustar, P. and Lockett, A. 2007. *Academic Entrepreneurship in Europe*, Cheltenham: Edward Elgar