

Three-ring entrepreneurial university: in search for a new business model

Article

Accepted Version

Audretsch, D. B. and Belitski, M. (2021) Three-ring entrepreneurial university: in search for a new business model. *Studies in Higher Education*, 46 (5). pp. 977-987. ISSN 0307-5079 doi: 10.1080/03075079.2021.1896804 Available at <https://centaur.reading.ac.uk/96626/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

To link to this article DOI: <http://dx.doi.org/10.1080/03075079.2021.1896804>

Publisher: Taylor & Francis

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the [End User Agreement](#).

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

Three-ring entrepreneurial university: in search for a new business model
(5921 words)

David B. Audretsch

School of Public and Environmental Affairs, Indiana University Bloomington
1315 E. 10th Avenue SPEA Bloomington, IN 47405, USA

Email: daudrets@indiana.edu

Department of Innovation Management and Entrepreneurship, University of Klagenfurt

Email: David.Audretsch@aau.at

Maksim Belitski¹

Henley Business School, University of Reading
Whiteknights campus, Reading, RG6 6UD, UK

Email: m.belitski@reading.ac.uk

ICD Business School Paris, IGS-Group, rue Alexandre Parodi, 12, paris, France

Email: mbelitski@groupe-igs.fr

Abstract

The entrepreneurship and higher education literatures suggest that universities cannot generate significant knowledge spillovers unless knowledge creation is followed by knowledge transformation and commercialization. Although several university business models have been proposed in the literature, extant studies assume that the elements required by and involved in the creation of new knowledge for commercialization are automatically aligned. A paucity of research exists explaining how entrepreneurial and knowledge capital congruence contributes to teaching, research and entrepreneurial activity – the “three-ring entrepreneurial university”. This study develops a conceptual business model of entrepreneurial universities, and introduces and demonstrates how knowledge spillover occurs, which stakeholders are involved and at which level of entrepreneurial university (individual, organizational, institutional).

Keywords: Three-ring entrepreneurial university, entrepreneurial capital, business model, stakeholders, knowledge transformation

1. Introduction

¹ Corresponding author

“Life is a three ring circus, All of the ups and downs of a carousel, That I know so well, Life is a three ring circus, Just one little ride on a merry-go-round, Goin' 'round and 'round and 'round and 'round and 'round” - Three Ring Circus, song by Blue Magic (1974).

The role of the university has changed considerably over time (Hazelkorn 2014; De Silva 2016; Baglieri et al. 2018; McAdam et al. 2017; Fuller et al. 2019), with multifaceted external environmental factors playing an increasing role in this change (Cunningham et al. 2017, 2018; Cunningham, 2019). The notion of the ‘entrepreneurial university’ has also evolved, with scholars applying the concepts of enterprise and entrepreneurship to the university context (Cunningham et al. 2019; Jones and Patton 2020). Alongside the university’s two traditional missions of teaching and research, Cunningham et al. (2019) incorporated a ‘third mission’ into the role of the entrepreneurial university that focuses on contributing to economic and social development (Miller et al. 2014, 2018).

The definition of the term ‘entrepreneurial university’ remains unclear, and its business model is a highly ambiguous concept incorporating both enterprise and entrepreneurship frameworks in a university context (Williams and Kitaev 2005; Jones and Patton 2020). The need to understand the business model of the entrepreneurial university is in the knowledge frontier of higher education and academic entrepreneurship research as it is a response to the significant challenges that universities have faced (Tadaki and Treman 2013; Lehmann and Menter 2016; Soliman et al. 2019). In particular, entrepreneurship activity as a new university business model has manifested itself as part of this response and commitment of resources to academic entrepreneurship, university-industry collaboration and knowledge commercialization.

While the “three-ring entrepreneurial university” is a new concept in the literature, prior research has demonstrated the role of each ring in establishing a business model (Grimaldi et al. 2011; Siegel and Wright 2015; Abreu et al. 2016). Along with the first and second rings - teaching and research - the entrepreneurial university’s third ring is entrepreneurship activity that enables knowledge transformation and commercialization between university and industry.

The entrepreneurial university business model is not a new phenomenon. Since the passage of the Bayh–Dole Act (1980) in the United States, there has been a worldwide expansion of university technology commercialization (Etzkowitz et al. 2000; Thursby and Thursby 2002) which has required new approaches to the university business model. In particular, the pursuit of the “three-ring entrepreneurial university” pulls and pushes universities to experiment with new business models in order to respond to external and internal challenges (Aldridge and Audretsch 2010; Miller et al. 2014; McAdam et al. 2017; Fuller et al. 2019). However, the main challenge is in a university’s ability to retain its two traditional rings of teaching and research, as well as its organizational and research culture (Slaughter and Leslie 1997; Fitzgerald and Cunningham 2016) which must be directly acknowledged in the university business model.

This new university business model requires a stronger congruence between knowledge capital (academic publications and inventions, applied research, investment in R&D) and entrepreneurial capital (research into and identification of market opportunities) (Rothaermel et al. 2007; Grimaldi et al. 2011; Audretsch 2007), reflecting on the heterogeneity between entrepreneurial universities (Abreu et al. 2016).

To date little research has focused on conceptualizing the congruence of the entrepreneurial university and its research basis. The literature regularly laments the paucity of

studies assessing how universities align entrepreneurship capital with knowledge in practice (Guerrero and Urbano 2012).

We argue that the congruence between knowledge and entrepreneurial capital is a core component of a new business model. This means that there is an interdependence between the major domains of entrepreneurial and knowledge orientation of a university at the individual, organizational and environmental levels (Guerrero et al. 2015; McAdam et al. 2017, 2018) and along the traditional and alternative routes of knowledge commercialization (Bradley et al. 2013; Belitski and Heron 2017).

This study makes a number of contributions to the entrepreneurship and higher education literatures. Firstly, it demonstrates how knowledge and entrepreneurial capital should be aligned to function as drivers of the university's 'third ring' (Lehmann et al. 2020) and support knowledge commercialization (Etzkowitz et al. 2000; Miller et al. 2014).

Secondly, building on the foundations of endogenous growth theory (Romer 1986) and the knowledge spillover of entrepreneurship theory (Acs et al. 2013), this study develops a framework which demonstrates the role and the intensity of congruence between knowledge and entrepreneurship capital in establishment of the "three-ring entrepreneurial university". This is how entrepreneurial universities could achieve their teaching, research and entrepreneurship missions at the individual, organizational and institutional levels.

The remainder of this study is organised as follows. The next section reviews the role of the entrepreneurial university in knowledge investment and the knowledge spillover of entrepreneurship. Section 3 outlines the three levels of the entrepreneurial university.

Section 4 introduces the business model, while Section 5 discusses our findings and section 6 concludes.

2. Theoretical framework

2.1. Knowledge transformation at the university

What distinguishes the entrepreneurial university from the Humboldt University is i) the strength of both knowledge capital and entrepreneurial capital (Audretsch 2014) and ii) the existence of the three levels of the entrepreneurial university: the individual level (skills and competences), the organizational level (infrastructure and processes) and the ecosystem (institutional) level (the entrepreneurial ecosystem with its stakeholders) (Guerrero and Urbano 2012; Guerrero et al. 2015).

The literature suggests that universities cannot be competitive or have a significant impact on their stakeholders (Perkmann et al. 2011) if knowledge creation is not followed by knowledge transformation and commercialisation. The reason an increase in operational, academic and applied research capabilities at universities does not result in knowledge transformation and commercialization can often be explained by the lack of a strong congruence between knowledge and entrepreneurial capital.

According to the endogenous economic growth theory (Romer 1986) and the knowledge spillover of entrepreneurship theory (Audretsch et al. 2006; Acs et al. 2013), knowledge commercialization is needed to support the entrepreneurial ecosystem along with innovation and regional economic growth (Bramwell and Wolfe 2008). The implicit assumption in the endogenous growth model is that universities invest in new knowledge and that knowledge spills over into regions within close geographic proximity (Acs et al. 2013).

The knowledge spillover of entrepreneurship theory gives the “knowledge filter” a central role. The knowledge filter can become a barrier between investments in knowledge and knowledge commercialization. The Bayh-Dole Act functions as a conduit to reduce the size of the filter and allow more knowledge to spillover via patenting, licensing, spinouts. The existence of the knowledge filter also suggests that investment in knowledge alone will not suffice to facilitate the knowledge spillover of entrepreneurship (Audretsch et al. 2006).

In order to reduce the knowledge filter and facilitate the knowledge spillover of entrepreneurship, many universities have engaged with entrepreneurial communities and connected to educational ecosystem stakeholders (Miller et al. 2014, 2018; Menter et al. 2018). These stakeholders include academic spin-offs, other universities, technology transfer offices (TTOs), private and not-for-profit firms and organizations, venture capital and angel investors (Klofsten and Jones-Evans 2000; Rasmussen et al. 2006; Kirby 2006; Hülsbeck et al. 2013).

Taken together, the role of the entrepreneurial university goes beyond the creation of knowledge via research and teaching (Guerrero et al. 2015, 2016), and is about knowledge transformation and commercialization (Caiazza et al. 2014; Baglieri et al. 2018).

2.2. The congruence between entrepreneurship and knowledge capital

For knowledge creation to be followed by knowledge commercialization universities must adopt open business models, which includes understanding the differing conditions that may prevail within the various universities adopting such open approaches (Sharifi et al. 2014). The higher education literature focuses on the teaching, research and

entrepreneurship aspects of entrepreneurial universities in explaining why some universities are better at commercializing knowledge than others. The extent of university knowledge commercialization can be determined by the congruence between investment in knowledge (knowledge capital) and the search for the market opportunities needed to transform knowledge (entrepreneurial capital) (Audretsch 2007). Since industry requires entrepreneurial capital to address the needs of the market, the university business model requires that they be congruent. Three-ring entrepreneurial universities accumulate strategic assets and resources and investigate the underexplored nature of markets. Understanding what can be commercialized and how it can be done requires the roles of all university stakeholders to be identified separately. We argue that the university business model should include both types of capitals to facilitate knowledge creation and transformation to external stakeholders (O'Shea et al. 2005; Rossi and Rosli 2015).

Knowledge - including technological knowledge - needs to be transformed in productive ways. This transformation of knowledge capital is a creating and generating process, in which both academic and entrepreneurial actors learn new skills and exchange knowledge by observing each other as well as by collaborating on scientific and applied projects with each other. Entrepreneurship capital is required to create new business models that enable knowledge transformation as a multi-actor and multi-dimensional process. This process is inherently entrepreneurial and complex, as it stretches over time and takes advantage of the various (physical and non-physical) dimensions of knowledge proximity between industry and university (e.g., geographical, cognitive, organizational, social, cultural and institutional) – together contributing to the three-ring entrepreneurial university business model. The ultimate objective of the three-ring entrepreneurial university is to increase knowledge transformation and

commercialization directly, with industry taking advantage of its various dimensions of knowledge proximity with the university.

Knowledge capital includes the creation of incentive systems for faculty members and technology-transfer offices (TTOs) (Rasmussen et al. 2006; Sharifi et al. 2017), internal processes for intellectual property assessment, and investment in internal R&D and other knowledge for commercialization (Lockett and Wright 2005). Entrepreneurial capital is directly associated with understanding the needs of both industry and the market, and initiating reward-based knowledge transformation and commercialization.

Given that knowledge capital enables the transformation of resources into desired outputs, entrepreneurial capital is capable of commercializing resources to the same extent that universities can transform knowledge to make it valuable to industry (Audretsch 2007, 2014; Rossi and Rosli 2015).

There are five aspects which require the congruence of entrepreneurial and knowledge capital. First, this congruence represents the academic research capability that reflects the extent to which a university can exploit and leverage resources to generate academic research outputs. Universities invest resources to increase the number of research-active scholars in their faculty and boost collaboration between industry and university for spinouts and start-ups (Thursby and Thursby 2002; O'Shea et al. 2005).

Secondly, knowledge and entrepreneurial capital congruence increases the effectiveness of applications for public and private funding and grants (Gulbrandsen and Smeby 2005; O'Kane et al. 2015), which may lead to higher academic research performance. However, even if universities have similar levels of resources, their academic

research outputs will be different because the ability to secure the grants and impact business is heterogeneous.

Thirdly, the congruence extends a university's ability to exploit knowledge generated by applied research and teaching (e.g., patents, licenses) (Wright et al. 2008), journal publications and conferences (Thursby and Thursby 2002), and spin-outs (Audretsch and Belitski 2019). If certain universities are more likely to commercialize their knowledge given the same level of knowledge capital, they can be considered to have a higher entrepreneurial capability and higher levels of knowledge. This is known as congruence of entrepreneurial and knowledge capital.

Fourthly, the congruence enables the use of both traditional and alternative routes of knowledge transformation between industry and university. The traditional route is via TTO while the alternative route is via knowledge commercialization directly with industry (VCs, other investors, direct industry funding) (Belitski et al. 2019). In other words, while patenting may depend on the efforts and abilities of TTOs and researchers, spin-out activity may depend on the efforts and abilities of individual scholars, researchers, and students. The business model of a university using the traditional commercialization route will focus on TTOs evaluating the commercial potential of academic research and liaising with individual scientists to co-create knowledge together with external partners via TTOs. This requires TTOs to be able to understand the markets for the new technologies (Wright et al. 2008). Knowledge capital is likely to be a primary source when commercializing knowledge via the traditional route. Entrepreneurial capital is required to understand the available commercialization opportunities, which TTOs may not have. Instead, they will rely on individual researchers to connect and advertise to industry (Belitski et al. 2019).

Lastly, the congruence can better generate economic returns from knowledge commercialization (e.g., licensing, contracts with industry, spin-outs) that will support the teaching and research university rings as well as the third entrepreneurial ring.

This “third ring” of a university is often seen as enabling university-industry interaction and academic entrepreneurship – a business model that represents a range of teaching, research and entrepreneurship activities, and encompasses the creation and transformation of knowledge (Aldridge and Audretsch 2010).

3. Three levels of entrepreneurial university

Past research has identified the individual, organizational, and environmental (system) factors which affect the entrepreneurship process in entrepreneurial universities (Rothaermel et al. 2007; Guerrero and Urbano 2012).

At a system level, the determinants of entrepreneurship are shaped by the framework and systemic conditions of the entrepreneurial ecosystem (Audretsch and Belitski 2017, 2021). This includes market size and demand conditions, as well as legal, institutional, social and cultural conditions. Institutions and culture may either hinder or facilitate entrepreneurial activity, because the role of a university changes from investing and creating knowledge to knowledge transformation and commercialisation.

Degroof and Roberts (2004) have suggested that in entrepreneurially developed macroeconomic contexts, a strong community is capable of selecting the best projects and allocating resources to them (Wright et al. 2008), clearing market failures.

At an organizational level, entrepreneurial universities aim at developing a stronger entrepreneurial mind-set in order to create attractive destinations for graduate students PhD

students and other faculty (Bienkowska et al. 2016). To support students with entrepreneurial ideas from all backgrounds to acquire an entrepreneurial mind-set, universities offer a wide range of modules that build the core entrepreneurial skills necessary for all graduate students to pursue entrepreneurial careers. At this level, knowledge transformation is influenced by the formal and informal institutional characteristics of regions and countries (Grimaldi et al. 2011; Guerrero et al. 2015). Researchers, departments, research support groups and central university management will differ in their response to the institutional environment in a way they align their efforts to become more entrepreneurial. Crafting a strategy to achieve a stronger integration between organizational and individual incentives to entrepreneurship requires stronger efforts at the organizational level.

At the individual level, scientists and faculty adhere to the established university culture of research and commercialization and entrepreneurial ecosystem (Audretsch and Belitski 2017). Bercovitz and Feldman (2008) analyse individual researchers who work to facilitate the commercialization of their inventions by responding to their department chairs and working with research support departments. They suggest academics and students should be more involved in commercialization.

4. The business model of a three-ring entrepreneurial university

4.1. Business model stakeholders

The classification of stakeholders at different levels of the entrepreneurial university could help us to identify the impact stakeholders have on knowledge commercialization (Rowley 1997), as well as highlight who represents an entrepreneurial university (Yusuf 2008). In this study we discuss the level different stakeholders operate at, and distinguish between three types

of stakeholder: general (students, faculty, administration and individual entrepreneurs), specialized (TTOs, patent offices, incubators and science parks) and systemic (government industry).

As stakeholders, government and industry operate at the ecosystem (environmental) level. Universities develop collaborative relations with them to secure private industry funding and government grants (O’Kane et al. 2015; Cunningham 2019; Cunningham et al. 2018, 2019). Government facilitates the knowledge transformation from university to industry (Guerrero et al. 2016).

Funding for research projects also comes from private industry, who provide inputs into idea generation and development and finance various aspects of research required by the market (Bradley et al. 2013; Lehmann and Menter 2016; McAdam et al. 2017).

At the individual level, the major general university stakeholders are students and individual scientists. Scientists collaborate with departments, administrations and individual entrepreneurs to facilitate basic applied research (Audretsch 2014). Entrepreneurial capital is important here, as knowledge transformation and commercialization is not possible without understanding the needs of the market. Within the knowledge commercialization process itself, scientists represent an important group of internal stakeholders (Clauss et al. 2018) and influence the emergence of knowledge spillovers via spinouts (Audretsch and Belitski 2019). If this entrepreneurial capital does not exist or is lacking, the attitude of university scientists towards knowledge transformation and commercialisation will not be supportive. This will result in an increase in the “knowledge filter”, driven by internal (individual and university) factors as well as moving to a more traditional route of knowledge commercialization where TTOs dominate

(Siegel and Waldman 2019). Scientists are also involved in teaching entrepreneurship and developing research projects (Hayter 2016).

Students participate in curricular and extra-curricular activities, including job placements and internships, and interact with each other and other businesses (Acosta et al. 2011). They can see which knowledge is uncommercialized at their university or in a company where they took an internship or job placement. This may result in the knowledge spillover mechanism being activated and the creation of a start-up or spin-out. Students and scientists together become a conduit of knowledge spillover entrepreneurship.

At the organizational level, a TTO as a strategic stakeholder leverages resources that are traditionally developed within a university but which have not been exploited or commercialized. TTOs make a limited contribution to knowledge commercialization at universities (Aldridge and Audretsch 2010) because they often fail to build institutional legitimacy for scientists and students. TTOs are considered to be a supporting function, often seen as an unnecessary bureaucratic procedure and functioning as job creation for university administration (Grimaldi et al. 2011). The organizational level requires ensuring the institutional legitimacy of TTOs and associated structures, which are there to facilitate knowledge transformation to external stakeholders. Regardless of the level of congruence between entrepreneurial capital and knowledge capital at university, universities may be able make decisions regarding the channel and external partners of knowledge transformation on behalf of faculty, which may impede incentives for individual stakeholders.

We expect that the congruence between knowledge and entrepreneurial capital may have a significant impact on knowledge commercialization performance if business model aims at

creating applied research capability to recognize and address market opportunities (Cunningham 2019).

4.2. Conceptualizing the three-ring entrepreneurial university

Extending endogenous growth theory and the knowledge spillover theory of entrepreneurship, this section explains why and how the congruence between knowledge and entrepreneurship capital can facilitate university research and knowledge transformation and in doing so reduce the size of the “knowledge filter” at university. Congruence between knowledge and entrepreneurial capital is not possible if two major functions - investment in knowledge and investment in entrepreneurship capital - are not aligned. How can these two types of capital be congruent, and how does this affect the new three-ring entrepreneurial university business model?

Some scholars studying higher education and open innovation in science (Beck et al. 2019) may argue that while the congruence between knowledge capital and entrepreneurial capital is a non-issue, it enables applied research capability building which results in higher performance and productivity. However, other scholars have suggested that both are strongly connected (Bramwell and Wolfe 2008; Audretsch 2014). A congruence is an endogenous process driven by university interactions with individual and system stakeholders, rather than an exogenous process.

The congruence between knowledge and entrepreneurial capital occurs at both the individual and organizational levels of entrepreneurial university. Indeed, knowledge commercialization intended to address market needs also requires individual stakeholders

to collaborate directly with industry and TTOs. Research teams and program leaders can also address industry directly, or connect to a TTO in the case of intellectual property generation. Once university stakeholders know what the market needs, the next step is the development of a value proposition in a business model.

The congruence between knowledge and entrepreneurial capital assists the university business model in four important ways. The first involves maximizing returns on knowledge investment (Guerrero et al. 2015, 2016). The second is in facilitating knowledge transformation via alternative and traditional routes of commercialization at both the individual and organizational levels of university (Bradley et al. 2013). The third is in providing direction and flexibility to react to new market opportunities, so that industry and universities tap into the market disclosure mechanism (Audretsch 2014). The fourth is in enabling the creation of products that the market wants and the products which the university can offer based on its specialization and the resources.

The congruence between knowledge capital and entrepreneurship capital at university is viewed as beneficial if two assumptions hold: firstly, it increases the likelihood of developing strategies more critical to the university and of obtaining financial support for knowledge spillover of entrepreneurship. Second, as the role of entrepreneurial capital in the university business model increases, there remains a possibility of pivoting to a different business model, including the pivots which assume changes in knowledge capital.

5. Discussion

Efforts undertaken by entrepreneurial universities to promote commercialization have changed in recent years (Miller et al. 2014; De Silva 2016; Sengupta and Ray 2017; McAdam et

al. 2017, 2018; Cunningham et al. 2019). The key difference is in the adoption of the three-ring entrepreneurial university business model, and the involvement of additional stakeholders in the creation, transformation and commercialization of knowledge. The discussion has now gone beyond the Triple Helix model (McAdam et al. 2018; Menter et al. 2018; Cunningham et al. 2017, 2018) to how universities need to be more ‘strategic’ in using their entrepreneurial and knowledge capitals to create products and services which the market needs.

The role of the three-ring entrepreneurial university is broader than just investment in knowledge via research and teaching. It also involves the subsequent entrepreneurial activity aimed at knowledge transformation and commercialization between university and industry (Guerrero et al. 2015; Hülsbeck et al. 2013; Lehmann and Menter 2016). The third ring also integrates the university’s role in engaging with university stakeholders at the individual, organizational and ecosystem levels in order to develop a competitive value proposition to external stakeholders (e.g. industry, government, etc.).

In reflecting on this, all university stakeholders - including university researchers, students, managers, industry, government, venture capitalists and science park agents - have a mandate to ignite the entrepreneurial ecosystem and foster the knowledge spillover of entrepreneurship.

Moving away from this view of industry–university collaboration, which focuses on the commercialization of research (Wright et al. 2008; Grimaldi et al. 2011), this study offers a broader multi-level and stakeholder view of entrepreneurial universities drawing on prior research (McAdam et al. 2018; Lehmann et al. 2020). A new business model needs to be adopted where both the applied capabilities of research and market opportunity

identification are congruent. To date very little research has conceptualized how this congruence takes place or identified the stakeholders involved.

6. Conclusion

The purpose of this study was to explore the congruence between knowledge and entrepreneurship capitals, as well as to develop a business model of the “three-ring entrepreneurial university”. Building on the endogenous growth theory (Romer 1986), and the knowledge spillover theory of entrepreneurship (Acs et al. 2013) we argue that entrepreneurial and knowledge capitals are at the heart of the three-ring entrepreneurial university business model and that they need to be congruent in order to spur innovation and knowledge spillover to industry. This study suggested that a multi-level entrepreneurial university business model structure can be adopted when all stakeholders are interrelated and step in (out) along the continuum of the knowledge commercialization process.

This study contributes to the university business model literature in a number of ways. Firstly, we demonstrate and discuss the role of congruence between entrepreneurship and knowledge capital and how it can be within the three levels (organizational, systemic and individual). Secondly, we identified the multiple stakeholders of the three-ring entrepreneurial university and considered how they contribute to the congruence. Finally, we develop the framework of the university business model and examine directly links knowledge transformation channels with entrepreneurial university outcomes.

This study addresses recent calls for more research on the underpinning business model(s) that support university mission change (McAdam et al. 2017, 2018; Soliman et al. 2019). Subsequent studies should focus on building upon the framework introduced in this paper. This

could involve analysing ways the existing strategic congruence could be used to monitor and track entrepreneurial and knowledge capital creation and realization. The model could be extended to pre-empt a change in strategy and implement a new alignment perspective by re-allocating university and ecosystem resources. More research is needed to unpack the role of congruence as the key driver for the university's mission change and to explain the relationship between congruence and the university knowledge filter.

Declaration of interest statement

Authors have no financial or non-financial competing interests, and declare no other conflicts of interest.

References

- Abreu, Maria, Pelin Demirel, Vadim Grinevich, and Mine Karataş-Özkan 2016. "Entrepreneurial practices in research-intensive and teaching-led universities." *Small Business Economics* 47(3): 695-717.
- Acosta, Manuel, Daniel Coronado, and Esther Flores. 2011. "University spillovers and new business location in high-technology sectors: Spanish evidence." *Small Business Economics* 36(3): 365-376.
- Acs, Zoltan J., David B. Audretsch, and Erik E. Lehmann. 2013. "The knowledge spillover theory of entrepreneurship." *Small Business Economics* 41(4): 757-774.
- Aldridge, Taylor, and David B. Audretsch. 2010. "Does policy influence the commercialization route? Evidence from National Institutes of Health funded scientists." *Research Policy* 39(5): 583-588.
- Audretsch, David B., and Erik E. Lehmann. 2005. "Does the knowledge spillover theory of entrepreneurship hold for regions?." *Research policy* 34(8): 1191-1202.
- Audretsch, David B., Max C. Keilbach, and Erik E. Lehmann. 2006. *Entrepreneurship and economic growth*. Oxford University Press.
- Audretsch, David B., 2007. "Entrepreneurship capital and economic growth ". Oxford Review of Economic Policy, 23(1): 63–78.
- Audretsch, David. B. 2014. "From the entrepreneurial university to the university for the entrepreneurial society". *The Journal of Technology Transfer* 39(3): 313-321.
- Audretsch, David B., and Maksim Belitski. 2017. "Entrepreneurial ecosystems in cities: establishing the framework conditions." *The Journal of Technology Transfer* 42(5): 1030-1051.
- Audretsch, David B., and Maksim Belitski. 2019. "Science Parks and Business Incubation in the United Kingdom: Evidence from University Spin-Offs and Staff Start-

Ups." In *Science and Technology Parks and Regional Economic Development*, pp. 99-122. Palgrave Macmillan.

Audretsch, David B., and Maksim Belitski. 2021. "Towards an Entrepreneurial Ecosystem Typology for Regional Economic Development: the Role of Creative Class and Entrepreneurship". *Regional Studies* <https://doi.org/10.1080/00343404.2020.1854711>.

Baglieri, Daniela, Francesco Baldi, and Christopher L. Tucci. 2018 "University technology transfer office business models: One size does not fit all." *Technovation* 76: 51-63.

Beck, Susanne, Maral Mahdad, Karin Beukel, and Marion Poetz. 2019. "The value of scientific knowledge dissemination for scientists—A value capture perspective." *Publications* 7(3): 54.

Belitski, Maksim, Anna Aginskaja, and Radzivon Marozau. 2019. "Commercializing university research in transition economies: Technology transfer offices or direct industrial funding?." *Research Policy* 48(3): 601-615.

Belitski, Maksim, and Keith Heron. 2017. "Expanding entrepreneurship education ecosystems." *Journal of Management Development*.

Bercovitz, Janet, and Maryann Feldman. 2008. "Academic entrepreneurs: Organizational change at the individual level." *Organization science* 19(1): 69-89.

Bienkowska, Dżamila, Magnus Klofsten, and Einar Rasmussen. 2016. "PhD students in the entrepreneurial university-perceived support for academic entrepreneurship." *European Journal of Education* 51, no. 1): 56-72.

Bradley, Samantha, Christopher S. Hayter, and Albert Link. 2013. "Models and methods of university technology transfer." *Foundations and trends in Entrepreneurship* 9(6).

Bramwell, Allison, and David A. Wolfe. 2008. "Universities and regional economic development: The entrepreneurial University of Waterloo." *Research policy* 37(8): 1175-1187.

Caiazza, Rosa, David Audretsch, Tiziana Volpe, and Julie Debra Singer. 2014. "Policy and institutions facilitating entrepreneurial spin-offs: USA, Asia and Europe." *Journal of Entrepreneurship and Public Policy*.

Clauss, Thomas, Aurel Moussa, and Tobias Kesting. 2018. "Entrepreneurial university: a stakeholder-based conceptualisation of the current state and an agenda for future research." *international Journal of Technology management* 77(1-3): 109-144.

Cunningham, James A., Maribel Guerrero, and David Urbano. 2017. "Entrepreneurial universities—overview, reflections, and future research agendas." In *The World Scientific Reference on Entrepreneurship: Volume 1: Entrepreneurial Universities 4 Technology and Knowledge Transfer*, pp. 3-19.

Cunningham, James A., Matthias Menter, and Conor O'Kane. 2018 "Value creation in the quadruple helix: A micro level conceptual model of principal investigators as value creators." *R&D Management* 48 (1): 136-147.

Cunningham, James A. 2019. "Principal investigators and boundary spanning entrepreneurial opportunity recognition: a conceptual framework." In *A Research Agenda for Entrepreneurship and Innovation*. Edward Elgar Publishing.

Cunningham, James A., Erik E. Lehmann, Matthias Menter, and Nikolaus Seitz. 2019. "The impact of university focused technology transfer policies on regional innovation and entrepreneurship." *The Journal of Technology Transfer* 44(5): 1451-1475.

Degroof, Jean-Jacques, and Edward B. Roberts. 2004. "Overcoming weak entrepreneurial infrastructures for academic spin-off ventures." *The Journal of technology transfer* 29(3-4): 327-352.

De Silva, Muthu. 2016. "Academic entrepreneurship and traditional academic duties: synergy or rivalry?." *Studies in higher education* 41 (12): 2169-2183.

Etzkowitz, Henry, Andrew Webster, Christiane Gebhardt, and Branca Regina Cantisano Terra. 2000. "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm." *Research policy* 29(2): 313-330.

Fitzgerald, Ciara, and James A. Cunningham. 2016. "Inside the university technology transfer office: mission statement analysis." *The Journal of Technology Transfer* 41(5): 1235-1246.

Fuller, Daniel, Malcolm Beynon, and David Pickernell. 2019. "Indexing third stream activities in UK universities: exploring the entrepreneurial/enterprising university." *Studies in Higher Education* 44(1): 86-110.

Gibb, Allan, and Paul Hannon. 2006. "Towards the entrepreneurial university." *International journal of entrepreneurship education* 4(1): 73-110.

Grimaldi, Rosa, Martin Kenney, Donald S. Siegel, and Mike Wright. 2011. "30 years after Bayh–Dole: Reassessing academic entrepreneurship." *Research policy* 40(8): 1045-1057.

Guerrero, Maribel, and David Urbano. 2012. "The development of an entrepreneurial university." *The journal of technology transfer* 37(1): 43-74.

Guerrero, Maribel, James A. Cunningham, and David Urbano. 2015. "Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom." *Research Policy* 44(3): 748-764.

Guerrero, Maribel, David Urbano, and Alain Fayolle. 2016. "Entrepreneurial activity and regional competitiveness: evidence from European entrepreneurial universities." *The Journal of Technology Transfer* 41(1): 105-131.

Gulbrandsen, Magnus, and Jens-Christian Smeby. 2005. "Industry funding and university professors' research performance." *Research policy* 34(6): 932-950.

Hayter, Christopher S. 2016. "A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem." *Small Business Economics* 47(3): 633-656.

Hazelkorn, E. 2014 "Rebooting Irish higher education: policy challenges for challenging times". *Studies in Higher Education* 39(8): 1343-1354.

Hülsbeck, Marcel, Erik E. Lehmann, and Alexander Starnecker. 2013. "Performance of technology transfer offices in Germany." *The journal of technology transfer* 38(3): 199-215.

Jones, David R., and Dean Patton. 2020. "An academic challenge to the entrepreneurial university: the spatial power of the 'Slow Swimming Club'." *Studies in Higher Education* 45(2): 375-389.

Kirby, David A. 2006. "Creating entrepreneurial universities in the UK: Applying entrepreneurship theory to practice." *The Journal of Technology Transfer* 31(5): 599-603.

Klofsten, Magnus, and Dylan Jones-Evans. 2000. "Comparing academic entrepreneurship in Europe—the case of Sweden and Ireland." *Small Business Economics* 14(4): 299-309.

Lehmann, Erik E., and Matthias Menter. 2016. "University–industry collaboration and regional wealth." *The Journal of Technology Transfer* 41(6): 1284-1307.

Lehmann, Erik E., Michele Meoli, Stefano Paleari, and Sarah AE Stockinger. 2020. "The role of higher education for the development of entrepreneurial ecosystems.": 1-9.

- Lockett, Andy, and Mike Wright. 2005. "Resources, capabilities, risk capital and the creation of university spin-out companies." *Research policy* 34 (7): 1043-1057.
- McAdam, Maura, Kristel Miller, and Rodney McAdam. 2018. "Understanding Quadruple Helix relationships of university technology commercialisation: a micro-level approach." *Studies in Higher Education* 43 (6): 1058-1073.
- McAdam, Maura, Kristel Miller, and Rodney McAdam. 2017. "University business models in disequilibrium—engaging industry and end users within university technology transfer processes." *R&D Management* 47(3): 458-472.
- Menter, Matthias, Erik E. Lehmann, and Torben Klarl. 2018. "In search of excellence: a case study of the first excellence initiative of Germany." *Journal of Business Economics* 88 (9): 1105-1132.
- Miller, Kristel, Maura McAdam, and Rodney McAdam. 2014. "The changing university business model: a stakeholder perspective." *R&D Management* 44(3): 265-287.
- Miller, Kristel, Rodney McAdam, and Maura McAdam. 2018. "A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda." *R&D Management* 48(1): 7-24.
- O'Kane, Conor, James Cunningham, Vincent Mangematin, and Paul O'Reilly. 2015. "Underpinning strategic behaviours and posture of principal investigators in transition/uncertain environments." *Long Range Planning* 48(3): 200-214.
- O'shea, Rory P., Thomas J. Allen, Arnaud Chevalier, and Frank Roche. 2005. "Entrepreneurial orientation, technology transfer and spinoff performance of US universities." *Research policy* 34 (7): 994-1009.
- Perkmann, Markus, Andy Neely, and Kathryn Walsh. 2011. "How should firms evaluate success in university–industry alliances? A performance measurement system." *R&D Management* 41(2): 202-216.
- Rasmussen, Einar, Øystein Moen, and Magnus Gulbrandsen. 2006. "Initiatives to promote commercialization of university knowledge." *Technovation* 26(4): 518-533.
- Romer, Paul M. 1986. "Increasing returns and long-run growth." *Journal of political economy* 94(5): 1002-1037.
- Rossi, F., and A. Rosli. 2015. "Indicators of University–Industry Knowledge Transfer Performance and Their Implications for Universities: Evidence from the United Kingdom." *Studies in Higher Education* 40 (10): 1970–91.
- Rothaermel, Frank T., Shanti D. Agung, and Lin Jiang. 2007. "University entrepreneurship: a taxonomy of the literature." *Industrial and corporate change* 16(4): 691-791.
- Rowley, Timothy J. 1997. "Moving beyond dyadic ties: A network theory of stakeholder influences." *Academy of management Review* 22(4): 887-910.
- Sengupta, Abhijit, and Amit S. Ray. 2017. "University research and knowledge transfer: A dynamic view of ambidexterity in British universities." *Research Policy* 46(5): 881-897.
- Sharifi, Hossein, Weisheng Liu, and Hossam S. Ismail. 2014. "Higher education system and the 'open' knowledge transfer: a view from perception of senior managers at university knowledge transfer offices." *Studies in Higher Education* 39 (10): 1860-1884.
- Siegel, Donald S., and Mike Wright. 2015. "Academic entrepreneurship: time for a rethink?." *British Journal of Management* 26(4): 582-595.
- Siegel, Donald S., and David Waldman. 2019. "Organizational And Psychological Issues In The Commercialization Of Research At Universities And Federal Labs." *les Nouvelles-Journal of the Licensing Executives Society* 54 (2).

Slaughter, Sheila, and Larry L. Leslie. 1997. "Academic capitalism: Politics, policies, and the entrepreneurial university.", 21218-4319.

Soliman, Samar, John Anchor, and David Taylor. 2019. "The international strategies of universities: deliberate or emergent?." *Studies in Higher Education* 44(8): 1413-1424.

Tadaki, Marc, and Christopher Tremewan. 2013. "Reimagining internationalization in higher education: international consortia as a transformative space?." *Studies in Higher Education* 38(3): 367-387.

Thursby, Jerry G., and Marie C. Thursby. 2002. "Who is selling the ivory tower? Sources of growth in university licensing." *Management science* 48(1): 90-104.

Yusuf, Shahid. 2008. "Intermediating knowledge exchange between universities and businesses." *Research Policy* 37(8): 1167-1174.

Williams, Gareth, and Igor Kitaev. 2005. "Overview of national policy contexts for entrepreneurialism in higher education institutions." *Higher Education Management and Policy* 17(3):125.

Wright, Mike, Bart Clarysse, Andy Lockett, and Mirjam Knockaert. 2008. "Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries." *Research policy* 37(8): 1205-1223.