

The origin of spin-offs – A typology of corporate and academic spin-offs

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CONTENTS

ABSTRACT	4
1. INTRODUCTION.....	5
2. TYPOLOGY OF SPIN-OFFS.....	5
2.1 Spin-offs as original start-ups.....	6
2.2 Spin-offs as derivative start-ups from existing activities.....	15
3. CLASSIFICATION OF PUBLISHED ARTICLES INTO THE TYPOLOGY OF SPIN-OFFS	18
4. OPEN RESEARCH QUESTIONS	24
4.1 Spin-off type	24
4.2 Context	25
5. CONCLUSIONS.....	28
REFERENCES.....	29

ABSTRACT

We provide a typology of corporate and academic spin-off types, distinguishing spin-offs involving new ventures from those that concern existing activities. We summarize the papers published in this special issue, relating them to the typology we develop. We conclude by developing an agenda for further research on spin-offs.

Keywords: Spin-offs, typology

JEL Codes: L26, M13, L33

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1. INTRODUCTION

Interest in entrepreneurial mobility has traditionally focused on the spatial movement of entrepreneurs across geographical regions (Agarwal, et al., 2010), including immigrant entrepreneurs, returnee entrepreneurs (Liu et al., 2010) and transnational entrepreneurs (Drori, et al., 2009). However, a parallel dimension of mobility is gaining interest and concerns the movement of entrepreneurs across organizations (Wright, 2011). Studies of this spin-off of entrepreneurial activities have increased over the last decade in a number of related literatures, including economies, entrepreneurship, finance, and strategy. This diversity of interest has spawned a profusion of overlapping terms that we argue have contributed to limiting our understanding of the contribution of spin-offs.

With this introductory article, and more generally with this special issue, we aim to weave a path through this confusing terrain so as to improve our appreciation and awareness of spin-off research and to stimulate further rigorous and interesting studies. To achieve this goal, in section 2 we develop a typology of spin-offs. Section 3 classifies the group of spin-offs that is investigated in each article published in this special issue into our proposed typology. The papers were initially presented at a workshop held at the ZEW Centre for European Economic Research in Mannheim, Germany, on November 10 and 11, 2011. Papers from the workshop that were submitted for consideration for the special issue were reviewed following the usual SBE process. The research questions and main findings of the final six papers chosen are discussed in section 3, providing a link to remaining open research questions that will be discussed in section 4.

2. TYPOLOGY OF SPIN-OFFS

Drawing upon the multilevel approach for understanding entrepreneurship expounded by Zahra and Wright (2011), we advance a comprehensive typology to explore the range of spin-offs (see Table 1). Specifically, we highlight the interaction between the environmental context from which a

The origin of spin-offs

spin-off emanates and the mode of the spin-off venture. With respect to the environmental context we distinguish between the commercial environment of for-profit corporations and the non-commercial environment associated with universities. With respect to the mode of the spin-off venture we distinguish whether the spin-off involves a new or existing activity.

Table 1: Typology of spin-offs

		Environmental context	
		University context	Commercial context
Firm level – spin-off mode	New firm	QUADRANT 1 Alumni start-up Academic spin-off (pure) Academic spin-off (hybrid)	QUADRANT 2 Corporate spin-off (use of intellectual property/assets) Employee spin-off (no direct use of intellectual property/assets)
	Existing activity	QUADRANT 3 Privatization buyout/buy-in of university research agency/station	QUADRANT 4 Management buyout of division Management buyin of division

The two dimensions we adopt help differentiate spin-offs into four main types portrayed by quadrants 1-4 in Table 1, within which there are various subtypes relating to nature of the entrepreneurs involved. In what follows, we elaborate on the elements of our typology.

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2.1 Spin-offs as original start-ups

Quadrant 1: Academic context

New firms that originate from the university context may appear in various forms. Basically, new firms in this quadrant are characterized by two

The origin of spin-offs

distinguishing attributes: (i) the transfer of knowledge and technologies generated at a university to the new firm; (ii) the firm's team of founders comprises members from a university¹.

Alumni start-ups are firms that were founded by university students or graduates. University knowledge that students and graduates absorb via university education becomes part of the start-ups' knowledge base and potentially gives alumni start-ups an initial advantage compared to start-ups founded by non-graduates. Universities typically play an indirect role in promoting this kind of academic entrepreneurship, notably by educating founders of alumni start-ups. Despite their increasing number, alumni start-ups have so far received little policy and research attention (Wright, 2013).

In contrast to alumni start-ups, academic spin-offs (also referred to as university spin-offs or spinouts) are subject of a huge and growing literature. Although there are various definitions of academic spin-offs, they all require the transfer of knowledge and technologies from the university to the academic spin-off. The transferred technology might be formalized intellectual property, e.g. the transfer of a patent via technology licensing (Di Gregorio and Shane, 2003). Alternatively, the transfer may consist of non-formalized technologies and research results (Djokovic and Souitaris, 2008). The discussion on transferred knowledge and technologies usually focusses on research results from natural sciences, computer sciences or engineering. However, academic spin-offs are also frequently based on results from social sciences, e.g. in the business consulting industry (Egelin et al., 2003).

Regarding the second distinguishing attribute of new firms in Quadrant 1, members of the founding team coming from a university, a narrow definition requires that an academic spin-off is set up by the inventor of the transferred knowledge and technology the spin-off commercializes (Smilor et al., 1990). Thus, the formation of an academic spin-off involves at least a

¹ In this paper we use the term "university" to refer to all kind of publically funded, not-for-profit research organizations. In particular, this includes extra university research institutes.

The origin of spin-offs

partial employment transition of a university researcher from academia to the for-profit private sector. This definition includes founders of academic spin-offs that remain affiliated with the incubator university and continue to work part-time for the university. If the whole team of founders consists of researchers that (partially) left the incubator university, we denote the new firm a pure academic spin-off. A hybrid type of an academic spin-off is a new firm set up by a team of founders that includes both university researchers and founders from outside the university sector. The latter may enrich the knowledge base of an academic spin-off through their commercial experience. Recall that pure and hybrid academic spin-off both require the transfer of knowledge and technology from the university to the academic spin-off. New firms founded by university researchers without being based on transferred knowledge and technologies are not classified as academic spin-offs.

This narrow definition of academic spin-offs is occasionally attenuated in studies on academic spin-offs. According to Nicolaou and Birley (2003), a technology spin-off is a new firm that commercializes research results originating from universities but that does not involve the inventor in the team of founders. Although the authors allow for the possibility of the university researcher having equity in the new company or offering advice on a consultancy basis, an employment transition of the university researcher is no longer necessary. Egehn et al. (2003) relax the criterion that academic spin-offs must commercialize universities' research results and denote as competence spin-offs those start-ups for which special skills and expertise the founders acquired at a university were essential to create the new firm.

Academic spin-offs started to establish their role as a major channel for technology transfer and commercialization of universities' research results in the 1960s. University researchers that left the not-for-profit scientific community to set up a for-profit firm were initially regarded with skepticism since working in a for-profit environment did not accord with traditional

The origin of spin-offs

norms of science (cf. the discussion in Stuart and Ding, 2006).² This skepticism receded with the growing number and importance of academic spin-offs so that the transition to the private sector is now widely accepted and considered as a potential career path of a university researcher. The literature discusses various motivations as to why a researcher leaves academia and starts a new venture. On one hand, “push factors” like dissatisfaction with bureaucracy and aversion towards a perceived low risk orientation of the university environment incite researchers to overcome the boundaries of a university (Chiesa and Piccaluga, 2000). On the other hand, desire for independence, identification of market opportunities or the wish to complete a project and to commercialize it on their own are “pull factors” that encourage the formation of a spin-off by university researchers (Morales-Gualdrón et al., 2009; Chiesa and Piccaluga, 2000). The desire or the opportunity to make money in the private sector may also motivate university researchers, although Weatherston (1995) suggests that monetary reasons are not the primary objective for researchers to set up an academic spin-off. Stuart and Ding (2006) emphasize that in the university context researchers are more likely to start a spin-off if they jointly worked with other scientists who already undertook a transition to the for-profit sector in order to commercialize their research results.

Since policy has recognized the importance of academic spin-offs, legislative reforms and public support programs have been adopted in numerous countries. The Bayh-Dole Act implemented in the United States in 1980 allowed universities to own the patents arising from research funded by the federal government. It changed significantly the incentives to commercialize university-based technologies and stimulated similar legislative reforms in other countries (see Grimaldi et al., 2011; Wright et al., 2007). Technology transfer offices (TTOs) were established throughout the university landscape. TTOs serve as intermediaries between university researchers and external experts or financiers and tend to help in the commercialization process of technologies emanating from university-

² Merton (1942, p. 270) outlines “four sets of institutional imperatives – universalism, communism, disinterestedness, organized scepticism – [that] comprise the ethos of modern science.” See also Macfarlane and Cheng (2008) for a recent discussion of Merton’s norms.

The origin of spin-offs

based research (see Siegel et al., 2007). In addition to establishing TTOs, universities attempt to create a “culture of entrepreneurship” both within their organizational structures and their curricula, offering entrepreneurship education to students from subjects others than business and economics (Egelin et al., 2010). Not least, numerous governmental programs provide academic spin-offs with financial support, both as equity financing (venture capital) or subsidized loans (Wright et al., 2006; Mustar and Wright, 2010).³

The literature has identified a number of factors by which newly founded academic spin-offs can be distinguished from other start-ups. First, since it is the primary purpose of an academic spin-off to commercialize knowledge and technologies emanating from university research, recent research results are incorporated into academic spin-offs’ products and services. Second, academic spin-offs possess a team of founders that, by definition, involves university researchers who at least partly transitioned from academia to the newly founded spin-off. Third, academic spin-offs may benefit from resources presumably provided by the incubator university. These may include patents or licenses, networks or financial resources. Thus, at time of start-up academic spin-offs may be endowed with a superior resource base when compared to other start-ups. From a dynamic perspective, academic spin-offs exploit and develop their initial resource base (Mustar et al., 2006). During the process of business development, academic spin-offs can still benefit from links to their incubator university, in particular by means of collaborations in innovation and R&D activities (Lejpras and Stephan, 2011). However, academic spin-offs may be distinctive in terms of the opportunities involved. For example, compared to corporate spin-offs, academic spin-offs that are more successful tend to have a broader technology (Clarysse et al., 2011a, b).

³ The aforementioned legislative reforms and mechanisms of public support are not exclusively related to academic spin-offs that involve the transition of a university researcher from the university sector to the private sector. Other channels of university knowledge commercialization that are targeted by legislation and various public support mechanisms include university-industry partnerships, science parks, patenting and licensing (see Phan and Siegel, 2006, for an overview). Moreover, founders of alumni start-ups may likewise benefit from entrepreneurship education.

The origin of spin-offs

Quadrant 2: Commercial context

Besides universities and public research institutes, established for-profit firms are important incubators of start-ups. Indeed, Fryges et al. (2010) show that 85% of all start-ups in Germany were set up by founders that previously worked in for-profit private firms. Similar to academic spin-offs, corporate spin-offs distinguish from other start-ups by receiving a transfer of knowledge from their parent firm. Parhankangas and Arenius (2003, p. 464) define a corporate spin-off as a “new business formation based on the business ideas developed within the parent firm being taken into a self-standing firm.” In addition to spin-offs based on new technologies and discoveries developed in the parent firm, Parhankangas and Arenius also consider so called restructuring spin-offs that were divestments of old established business units of the incumbent firm. According to our typology, these firms are discussed in Quadrant 4 as spin-offs from existing activities whereas in this section we focus on new firms commercializing new business ideas.

The transfer of knowledge from the parent firm is a distinguishing characteristic of a corporate spin-off. Sapienza et al. (2004) point out three types of knowledge that are potentially transferred from the parent firm and might give the corporate spin-off a profound knowledge base as a source of its competitive advantage: production, technology and marketing knowledge. The transfer of knowledge can take place in an informal way, e.g. via tacit knowledge, or in a formal way, e.g. via patents or licenses that are commercialized by the corporate spin-off.

In addition to the transfer of knowledge, the formation of a corporate spin-off involves the transition of entrepreneurs from the parent firm to the newly founded spin-off. The transition of entrepreneurs is relevant for both corporate spin-offs that were set up by former employees of parent firms who decided to leave their parent company and start their own business (“entrepreneurial spin-offs”; Van de Velde et al., 2007) and for corporate spin-offs that were initiated by the parent firm itself (“assisted spin-offs”). In the latter case, either the employee who developed the new business idea

The origin of spin-offs

or technology or an experienced manager of the parent firm might be appointed to head the assisted spin-off.

Entrepreneurs who leave the parent firm in order to start a new firm might be accompanied by other employees with whom they previously worked together in the parent firm. New firms that employ a group of employees that previously worked for the same parent firm are called employee spin-offs. The latter do not necessarily involve the transfer of a new business idea or a new technology from the parent firm to the spin-off. However, it is assumed that intellectual assets are embodied in the group of employees that move from the parent firm to the spin-off so that intellectual assets are transferred indirectly. A substantial transfer is assumed to occur if the group of employees that transitioned from the parent firm to the spin-off account for a predefined share of the spin-off's workforce. Restricting their sample to firms with at least five employees, Muendler et al. (2012) categorize a new firm as an employee spin-off if at least 25% of the new firm's workforce previously worked for the same parent firm. Eriksson and Kuhn (2006) define an employee spin-off as a start-up where more than 50% of the start-up's employees transitioned from the same existing firm to the spin-off (sample of new firms with two to ten employees).

In quantitative studies, corporate spin-offs are typically operationalized by new firms set up by founders who previously worked in the same industry the spin-off is operating in (e.g. Klepper, 2002; Franco and Filson, 2006). These kind of "horizontal" spin-offs (Muendler et al., 2012) have been shown to contribute significantly to the development of an industry. However, Muendler et al. (2012) emphasize the importance of "vertical" spin-offs, i.e. spin-offs founded in an industry other than that of the parent firm, as a vehicle of inter-industry knowledge transfer.⁴

⁴ Corporate spin-offs are usually regarded as new firms that spun off from for-profit private firms. However, the concept of (entrepreneurial) corporate spin-offs does theoretically not exclude start-ups that are based on ideas emanating from state-owned companies. Although the business idea developed for example by an engineer working for a state-owned company might be similar to an idea developed in a for-profit private firm, the parent-spin-off relationship will be different. For instance, it is unlikely that the state-owned parent company will hold a share in the corporate spin-off or will provide any other kind of financial support.

The origin of spin-offs

The trigger to set up a corporate spin-off differs between spin-offs initiated by the parent firm and those created by employees who wish to realize their business ideas. The main reason for a parent firm to start a corporate spin-off is that it developed a new technology or discovery that does not fit with the parent's core activities. Instead of expanding the parent's scope of activities or abandoning the new technology, the parent firm may decide to establish a new firm for commercializing the new technology (Van de Velde et al., 2007). Corporate spin-offs initiated by the parent firm are regarded as important sources for future growth of the parent firm (Bruneel et al., 2013).

Corporate spin-offs founded by former employees of the parent firm can be grouped into opportunity spin-offs and necessity spin-offs (Buenstorf, 2009). The trigger for an opportunity spin-off is the employee's wish to pursue an opportunity (a new business idea, a new technology etc.) the parent company is either unable or unwilling to exploit. A necessity spin-off is a new firm that is triggered by adverse events at the parent firm. These adverse events may involve shrinkage or even expected closure of the parent firm, but also other events like the acquisition by a competitor or the refocusing of the parent firm's business strategy. In face of such adverse shocks, employees may become confronted with a higher probability of job loss or a lower expected income from a further employment at the parent firm. This may be the trigger for them to leave the parent firm and start a spin-off. However, as Buenstorf (2009) emphasizes, founders of a necessity spin-off may also have discovered a business opportunity during their work at the parent firm that they did not pursue until the firm experienced an adverse shock.⁵

Corporate spin-offs may benefit from the relationship to their parent firm in various ways. Since the business idea was developed within the parent firm, the corporate spin-off can start, for example, with a more mature technology so that the corporate spin-off has to invest less in technology

⁵ Van de Velde et al. (2007) point out the employee's wish to become self-employed and to work on an independent basis as a motivation for creating a corporate spin-off. However, the aspiration to become self-employed usually also coincides with the recognition of an entrepreneurial opportunity.

The origin of spin-offs

development than other start-ups (Clarysse, et al., 2011b). In later stages of their development, corporate spin-offs may cooperate with their parent firms in innovation and R&D activities influencing the innovativeness of corporate spin-offs (Lejpras and Stephan, 2011). Corporate spin-offs may also collaborate with their parent firms in other functional areas like production, marketing or distribution. Collaborations are particularly beneficial if the spin-off and the parent firm have complementary resource bases so that they can exploit synergy effects from sharing resources (Parhankangas and Arenius, 2003; Sapienza et al., 2004). Even without collaboration activities, the corporate spin-off is likely to profit from social capital and networks (e.g. with customers, suppliers or external financiers) the founders established during their work at the parent firm (Stam and Elfring, 2008).

The parent-spin-off relationship is frequently reflected by the parent firm holding an equity share of the corporate spin-off. Parent firm ownership is in particular relevant for assisted spin-offs initiated by the parent firm and for entrepreneurial spin-offs initiated by a former employee but which were nevertheless supported by the parent firm (Parhankangas and Arenius, 2003). Since corporate spin-offs are usually defined as independent firms, most studies require minority ownership of the parent firm (e.g. Sapienza et al., 2004, who require that less than 50% of the spin-off's stock is held by other corporations).⁶

The typology of spin-offs in Quadrant 2 does not define mutually exclusive groups of spin-offs. A corporate spin-off based on the transfer of intangible assets may or may not involve the transfer of employees from the same workplace so that some corporate spin-offs can concurrently be classified as employee spin-offs. Furthermore, it is possible that a spin-off from Quadrant 2 coincides with an academic spin-off. As Mueller (2010) pointed out, academic spin-offs are frequently founded years after the founder left the academic institution. Even a ten year time-lag between leaving academia and the establishment of the academic spin-off is not

⁶ In contrast, Ito (1995) defines a corporate spin-off as a firm with a parent's partial ownership that ranges between more than 0% and less than 100%.

The origin of spin-offs

uncommon. During that time the founder probably worked for a private company. It is thus possible that the newly founded spin-off is based on the transfer of knowledge and technologies from both the academic institution and the private firm the founder previously worked for. Evidence suggests that this type of spin-off performs better than academic spin-offs where the founder does not have commercial work experience (Wennberg et al., 2011).

2.2 Spin-offs as derivative start-ups from existing activities

Quadrant 3: Academic context

The creation of spin-offs as derivative start-ups recognizes the transfer of knowledge and technology assets to a commercial, quasi-private context in which the university typically retains a significant equity stake. Activities may also have developed initially within an academic context on the basis of research contracts but which begin to generate commercial revenues as the practical relevance comes to attract interest. Being part of a university may constrain the ability to exploit revenue generating activities fully because of the constraints imposed by a university environment.

Assessments of the boundaries of the public sector may also come to question why certain activities need to be within public ownership. For example, extensive privatization of public sector activities in the UK began with the Conservative governments during the 1980s and continued into the 1990s. While these programs saw extensive transfer to the private sector of major state enterprises they also saw the privatization of divisions of commercial state-owned enterprises and some local authority activities as spin-offs. Of particular relevance for this quadrant, privatizations as spin-offs also involved long-standing quasi-commercial research activities carried out at universities or which were associated with universities (Robbie and Wright, 1996; Wright et al., 1993). For example, the Open University Press was bought out from the Open University.

Quadrant 4: Commercial context

The origin of spin-offs

Spin-offs of existing activities in a commercial context can take the form of a management buyout or buyin of a division. In general, such buyouts and buyins involve the creation of a new independent entity in which ownership is concentrated in the hands of management and private equity (PE) firms, if present, with substantial funding provided by banks (Gilligan and Wright, 2012). PE firms become active investors through taking board seats and specifying contractual restrictions on the behavior of management that include detailed reporting requirements. In a management buyout (MBO), existing incumbent management takes a substantial proportion of the equity. A management buyin (MBI) is an MBO in which the leading members of the management team are outsiders. Where there is a continued trading relationship, the former parent may maintain a minority equity stake in the buyout, which helps maintain a close relationships, provides legitimacy for the newly independent venture, and enables the former parent to avoid potential embarrassment that it sold the division too cheaply but allowing it to share in any upside when the buyout/buyin is eventually exited (sold) by the new investors.

The benefits of these kinds of spin-offs arise as a result of the bureaucratic performance measures that in large diverse organizations can restrict experimentation and constrain innovative activity. Following buyout, instead of having to adopt headquarters' controls designed to optimize the goals of the diversified parent company, the new owner-managers can decide what is best for the business. This approach may be especially important in cases where there are prospects for significant product and process innovation. For example, entrepreneurial buyouts may emerge in technology-based industries where in a complex organization the parent did not have the capability to manage or understand the technology, or to appropriately incentivize the management of the activity. In contrast, the divisional management may have superior and idiosyncratic skills to process limited and incomplete information on new opportunities (Wright et al., 2000).

In some cases, spin-off buyout may continue to trade with the parent or

The origin of spin-offs

benefit from the link with the parent. Evidence suggests that buyout spin-offs engage in efforts to reduce the asymmetry of interdependence with their former parents by seeking to exploit new customers and markets (Wright, 1986).

Parent corporations may also spin-off existing activities in two primary ways. First existing activities may be separated from the parent with the parent maintaining a controlling interest in the form of corporate venturing (Phan et al., 2009; Narayan et al., 2009). For example, a parent corporation may need to find a way to incentivize managers to develop entrepreneurial activities outside the constraints of the corporate remuneration structure.

Second, parent corporations may spin-off existing activities by creating a newly listed corporation. This may involve the creation of two new listed corporations in which shareholders of the former parent receive a new set of shares in the “new” parent and the spin-off firm replacing their initial holding in only the “old” parent corporation. These spin-offs do not involve cash but the shareholders have a new opportunity set that enables them to adjust their holdings in the new separated entities according to their risk return preferences, which they were not able to do before. The separation may enable greater efficiency through the adoption of governance and control structures and processes that are more specific to each entity. For the corporations concerned, they may be able to send clearer signals to the stock market about the strategies and prospects of the separated entities than was possible beforehand. This separation may also make it easier for high growth parts of a formerly diversified corporation to raise significant funds. A meta-analysis undertaken by Veld and Veld-Merkoulova (2009) shows that spin-off announcement generate significant abnormal stock market returns and that these returns are higher for larger spin-offs and for spin-offs of unrelated divisions. However, this meta-analysis found that spin-offs where the rationale was the information asymmetry between the management of the firm and the external capital market did not result in significant abnormal returns.

The parent organization may provide capabilities for a spin-off through

The origin of spin-offs

imprinting its own routines into the new firm (Helfat and Lieberman, 2002). Ferriani et al. (2012) consider the spin-off of ARM Semiconductors from Acorn Computers to examine the benefits and downsides to learning arising from the organizational and technological heritage of the spin-off. They suggest that to be able to achieve novelty, spin-offs may need to unlearn inappropriate practices and create their unique competitive identity through a process of reimprinting.

3. CLASSIFICATION OF PUBLISHED ARTICLES INTO THE TYPOLOGY OF SPIN-OFFS

Our typology provides a comprehensive classification of spin-offs. It is not the objective of this special issue to cover all different types of spin-offs. Nonetheless, we demonstrate how the published articles fit into our typology. Table 2 provides an overview of these articles.

Bonaccorsi et al. approach the topic of spin-offs from a broader perspective. Their unit of analysis are newly founded knowledge-intensive firms in Italy, defined as newly registered firms in knowledge-intensive industries. Registry is compulsory for both original new firms and derivative firm formations like buyouts and buyins. Thus the study of Bonaccorsi et al. is related to both firm level spin-off modes in our typology (i.e. new firms and spin-offs from existing activities). Further, spin-offs in knowledge-intensive sectors can likewise emanate from a university or a commercial environment. However, Fryges et al. (2010) pointed out that corporate spin-offs do not cluster into knowledge-intensive sectors; the cross-sectoral distribution of corporate spin-offs is similar to that of all start-ups. On the contrary, academic spin-offs are frequently regarded as knowledge-intensive firms per se (Wright et al., 2007). Bonaccorsi et al. argue that it is likely that a number of new knowledge-intensive firms can be classified as academic spin-offs. However, their data set does not allow for the separation of these spin-offs within the larger group of knowledge-intensive firms.

The origin of spin-offs

Table 2: Overview of articles in the special issue

Authors	Research question	Theoretical/ empirical background	Unit of analysis/ definition of spin-off	Methodology	Results
Bonaccorsi, Colombo, Guerini and Rossi Lamastra	How far in space does university knowledge flow to breed the creation of knowledge-intensive firms, depending on the nature (codified or tacit) and quality of this knowledge?	Literature on spatial knowledge spillovers on both firm- and geographical-area level.	Number of newly founded knowledge intensive firms (KIF) in each NUTS 3 region (province) in Italy.	Negative binomial regression models	Knowledge codified in academic patents positively affects new KIFs creation both locally and in distant regions, whereas knowledge codified in publications and embedded in university graduates is highly localized. The effects are confined to high-quality universities.
Huyghe, Knockaert, Wright and Piva	How and why do hybrid technology transfer offices (TTO) engage in boundary spanning activities that help nascent spin-off companies move through the pre-spin-off process?	Boundary spanning theory (external boundary spanning and internal boundary spanning); proximity literature	Nascent academic spin-offs, irrespective of the phase of the spin-off process, the technology or type of spin-off	Qualitative case study analysis	Both centralized and decentralized TTOs engage in external and internal boundary spanning activities. There are differences in the types of boundary spanning activities they perform and the parties they engage with.
Czarnitzki, Rammer and Toole	The creation of academic spin-offs that are founded by university researchers imposes higher social cost than the creation of industry start-ups (due to a decrease in production and disclosure of academic research). Do academic spin-offs generate a performance premium that offsets the higher social costs?	Theoretical reasons why academic spin-offs should perform better than industry start-ups: (i) Selection and exploitation of market opportunities (ii) Different growth prospects for academic spin-offs based on the human and social capital of spin-off founders	Academic spin-offs defined as new firms founded by former or current university employees Research spin-offs defined as academic spin-offs that are based on research results generated by spin-off founders during their activity at the university	Heckman selection model	Academic spin-offs exhibit a performance premium of 3.4% higher employment growth over industry start-ups. The performance premium varies across types of academic entrepreneurs (university researchers versus non-researchers) and by the academic disciplines of spin-off founders.
Lejpras	Are there any differences in R&D and innovation behavior between established academic spin-offs and otherwise created firms? To what extent are these differences driven by networking and cooperation activities?	Literature on knowledge transfer from universities to academic spin-offs Literature on persistence of firm innovativeness Literature on the importance of cooperation activity and networking for firm innovativeness	Academic spin-offs from both universities and research institutes	Probit regression analysis and nearest neighbor matching	Established academic spin-offs engage in R&D and innovation activities more frequently than other companies. However, this result is related to academic spin-offs' higher intensity of cooperation activity and close, face-to-face interactions with universities, and not to type of firm creation.

The origin of spin-offs

Table 2: Overview of articles in the special issue (continued).

Stephan	<p>Are academic spin-offs more innovative than other knowledge-intensive firms? Are academic spin-offs more successful in attracting public innovation support? Are spin-offs emanating from universities different from those emanating from public research institutes?</p>	<p>Literature on (superior) performance of spin-offs. Literature on the important of location factors (e.g. infrastructure) and geographic proximity to collaboration partners (universities or other companies). Literature on the role of public support for spin-off development</p>	<p>Academic spin-offs from both universities and research institutes</p>	<p>Propensity score matching</p>	<p>Academic spin-offs have more patent applications, more radical product innovations, and are more successful in attracting public innovation support compared to similar firms. Spin-offs emanating from universities are more likely to have applied for a patent, whereas spin-offs emanating from research institutes show a higher share of turnover generated by radical innovations.</p>
Fryges, Müller and Niefert	<p>Do corporate spin-offs benefit from the transferred idea and outperform other start-ups in terms of employment growth and post-entry innovation activities?</p>	<p>Theoretical explanations for the emergence of corporate spin-offs. Literature on knowledge and technology transfer from incubator firms to corporate spin-offs. Literature on (superior) performance of corporate spin-offs.</p>	<p>Corporate spin-off defined as start-up for which a new idea that the founders developed during their time as an employee in a private company was essential for setting up the new firm</p>	<p>Propensity score matching</p>	<p>An essential idea leads to higher post-entry innovation activities but does not improve employment growth. In order to assess the effect of a transfer of knowledge and technology from an incumbent firm to a start-up, it is important to differentiate between varying types of knowledge and technology transfer.</p>

The origin of spin-offs

Bonaccorsi et al. investigate whether knowledge generated at a university boosts the number of knowledge-intensive start-ups only within the region the university is located in or also in geographically remote regions. In their analysis, the authors distinguish between codified knowledge (patents or scientific publications) and tacit knowledge embodied in university graduates. They find that the effect of tacit knowledge and knowledge codified in scientific publications is limited to the university's region. Only knowledge codified in patents influences the creation of knowledge-intensive firms beyond the university's own region.

Most articles in this special issue fall into Quadrant 1, new firms from the university context. Regarding the timeline of creating academic spin-offs, Huyghe et al. focus on the pre-start-up phase of nascent spin-offs at the University of Ghent. The authors conducted a longitudinal multiple case study analysis and tracked the evolution of six nascent academic spin-offs during the pre-start-up process. In all six cases, the pre-founding team comprised at least four persons, in three cases non-academic team members (consultants or engineers) were involved in the pre-start-up process. Thus, the study examines both pure and hybrid nascent academic spin-offs.

Huyghe et al. address the research question how the technology transfer office (TTO) of the University of Ghent that has a hybrid structure composed of centralized and decentralized TTO levels helps nascent spin-offs through the pre-start-up process. In addition to interviews with pre-founding team members of the six nascent spin-offs, decentralized and centralized TTOs and department heads were interviewed. Huyghe et al. show that the centralized level of a TTO on the one hand helps establishing contacts between pre-founding members and external experts and financiers. On the other hand, it bridges the gap between the pre-founding team and the central university level. The decentralized level assists in establishing contacts to industrial companies and improves the collaboration between different research teams and between pre-founding team members and the centralized TTO.

The origin of spin-offs

Czarnitzki et al. study spin-offs from the university context in knowledge-intensive industries in Germany. Their data set covers original new ventures (Quadrant 1), excluding derivative firm formations like privatizations of existing university activities (Quadrant 3). A new firm is denoted an academic spin-off if it was founded by university employees who have partially or completely moved from a public research organization to their new firm. In order to be classified as an academic spin-off it is sufficient if at least one founder previously worked in a public research organization. Still, it is possible that founders from outside the university joined the founding team, allowing for hybrid academic spin-offs in the data set. The transition of university researcher from the university environment to the for-profit private sector involves social costs due to a decrease in academic research and its disclosure to the public. Czarnitzki et al. show that compared to other start-ups in knowledge-intensive industries academic spin-offs exhibit a “performance premium” in terms of a higher employment growth rate that contributes to offset these social costs.

The two articles by Lejpras and Stephan are based on the same data sets of spin-offs from the university environment in Eastern Germany. Although most spin-offs surveyed can be assumed to be academic spin-offs set up by former or current researchers (either as pure academic spin-offs or in a hybrid form, Quadrant 1), privatization buyouts or buyins from universities may also be encompassed (Quadrant 3).⁷

Lejpras analyzes the innovation behavior of established academic spin-offs. Spin-offs are more innovative both in terms of innovation input (R&D) and output (product and process innovations, patents) than other start-ups. However, as Lejpras demonstrates, the superior innovation behavior of academic spin-offs can be traced back to more intense collaboration activities in the fields of basic research, product and process development. Being an academic spin-off is not responsible for the superior innovation activities once collaboration activities are considered.

⁷ We thank Anna Lejpras and Andreas Stephan for pointing this out in a personal communication.

The origin of spin-offs

Like Lejpras' study, the paper of Stephan explores whether spin-offs are more innovative than other firms. He extends Lejpras' analysis by, first, accounting for location factors as additional confounding variables and, second, differentiating between spin-offs from universities and those emanating from public research institutes. Moreover, Stephan investigates whether spin-offs are more successful in obtaining public support for financing their innovation activities. In his model, differences in innovation performance between spin-offs and other start-ups remain significant after controlling for firm-specific and location factors. Further, spin-offs are more likely to receive public innovation support. Spin-offs from public research institutes are more successful in commercializing radical product innovations whereas spin-offs from universities more likely apply for patents.

In contrast to the other articles published in this special issue, the environment of the study of Fryges et al. is the commercial context. This paper's unit of analysis are German corporate spin-offs defined as start-ups for which new ideas that the founder developed during employment in a private company were essential for setting up the new firm. New firms founded as management buyouts and management buyins are excluded from the data set so that the study of Fryges et al. falls into Quadrant 2. The authors' perception of new ideas that are transferred from an incubator firm to the corporate spin-off refers to new products, new technologies, new production processes or new management concepts. In this way, new ideas constitute a particular kind of intangible assets that are transferred to and used by a corporate spin-off. Nevertheless, Fryges et al. allow for a transfer of employees from the same workplace (employee spin-offs) and corporate spin-offs may operate in the same sector as the incubator firm but these are not preconditions to be classified as a corporate spin-off.

Fryges et al. examine whether corporate spin-offs outperform other start-ups with respect to employment growth and superior innovation activities. Thus, the study is related to that of Czarnitzki et al. in this special issue that analyzes differences in employment growth between academic spin-offs

The origin of spin-offs

and other firms and shows parallels to the two studies of Lejpras and Stephan who focus on academic spin-offs' innovation activities. Fryges et al. find that the transfer of essential ideas coheres with superior innovation activities of corporate spin-offs but does not increase employment growth.

4. OPEN RESEARCH QUESTIONS

In developing our agenda for further research, we adopt a broad input-process-output model of spin-offs and, drawing on our typology in Table 1, consider issues relating to the spin-off type and the context from which the spin-off emerged (Table 3). We distinguish outcomes in terms of the direct innovation and performance implications for spin-offs themselves from their indirect effects through spillovers to other firms and the macroeconomic environment.

4.1 Spin-off type

The objectives and strategies may differ according to the type of spin-off, which may lead to different processes of spin-off development and eventual outcomes.

A major debate in the entrepreneurship literature concerns whether entrepreneurs discover opportunities that already exist, or whether they create them (Alvarez and Barney, 2007). Some entrepreneurs discover business opportunities by being alert to gaps in the market while others engage in purposeful search processes based on their prior specific knowledge (Fiet, 2002). Entrepreneurs may be able to exploit these opportunities by gathering information from existing markets. In contrast, at the start of the opportunity creation process entrepreneurs likely have incomplete information as the market does not yet exist and is difficult if not impossible to define and potential customers are not aware of their future preferences. Spin-offs involving established businesses may be more likely to involve the discovery of opportunities while new firms may focus on opportunity creation. However, there may be a difference between the university and commercial environment. As Clarysse et al. (2011b) show, corporate spin-offs tend to be based on narrow technology while spin-offs

The origin of spin-offs

from universities are more likely based on broader platform technologies. What is more, new firms may differ within the same environment. Fryges et al. in this issue find that new firms in the commercial environment distinguish from each other according to the varying types of knowledge and technology transfer they received from their parent firms.

An important outcome issue touched upon by Leipras, this issue, and also examined by Ferriani et al. (2012) concerns how long spin-offs benefit from the transfer of capabilities and resources from their parent organization. The benefits may be short-lived and the spin-off may need to develop new capabilities to become successful in different market conditions. At present we lack comparative analyses of differences between spin-off types in terms of the longevity of benefits, the processes engaged in by spin-offs to make changes, and the nature of the outcomes.

While spin-offs may involve smaller even peripheral activities that the parent is not interested in or does not have the skills to develop, it may be that the spin-off becomes more successful than the parent as it has the flexibility to adapt to and exploit new market opportunities. At present, we lack systematic evidence on these outcomes and the circumstances in which they arise, especially in respect of comparative evidence across different types of spin-off.

4.2 Context

Parent organizations in different contexts may have different objectives and different resource endowments, especially technological resources that give rise to different potential opportunities that they can develop in-house or choose to spin-off. As Bonaccorsi et al. show, the ability of a university to breed knowledge-intensive start-ups depends on the quality of the knowledge generated by that university. Moreover, in their paper Huyghe et al. demonstrate the importance of the design of university TTOs for academic spin-offs' pre-start-up process. However, little is known about how differences in TTOs influence the start-up process itself and the subsequent development of academic spin-offs.

The origin of spin-offs

Table 3: Spin-off research agenda

	Inputs: Strategies and opportunities	Processes	Outcomes: Innovation and performance	Outcomes: Spillovers and effects on the macroeconomic environment
Spin-off type	To what extent do the objectives and strategies differ between spin-off types? Is there a difference between opportunity discovery versus creation and spin-off type?	How do the challenges in transitioning to an independent existence differ between different types of spin-offs? How does the input transferred from the parent organization interact with other production factors in the production process/knowledge production process (e.g. knowledge transferred from the parent organization interacts with knowledge acquired from other sources)?	Which type(s) of spin-off are most innovative? Does the nature of innovation differ across different types of spin-off? How do success-failure rates differ across spin-off types? To what extent do spin-offs become more successful than their former parents? How do other measures of performance (growth rates, productivity etc.) differ across spin-off types? Which spin-offs benefit from the transfer (of IP, employees etc.) they received from their parent organization for short and longer periods; how long-lasting is the effect of being a spin-off on firm development?	To what extent do the spatial spillovers differ between different types of spin-offs? What are the social benefits of different types of spin-offs? What are the roles of different types of spin-offs in national innovation systems?
Context	Which parent organizations actively select spin-off options/support spin-off start-ups? To what extent do spin-offs arise where employees have had disagreements with their employer? How do parent organizations in different contexts select between spin-off options? To what extent are strategies influenced by external factors? (e.g. governance, markets) What is the career trajectory of employees who leave organizations but set-up spin-offs some time later?	How do the extent and the way of everyday business relations between the parent organization and spin-off differ between types of spin-off? How does continuing dependence on the former parent differ between types of spin-offs?	How do the different types of spin-off generate different types and amounts of returns to parent organizations?	To what extent does the type of university or corporate context affect the nature of spillovers?

The origin of spin-offs

At present, we also know little about the interaction between the internal factors of a parent organization that lead to the decision to spin-off an activity and external factors. These internal and external contextual issues, such as the complexity and stability of the market (Clarysse et al., 2011a) may also vary between different types of spin-off.

Spin-offs from different contexts may depend on their former parent organization in different ways, and following spin-off this interdependency may also need to be managed differently. In some cases, the spin-off may depend on the former parent for a continued supply of innovations and/or trading relationships, while in other cases the spin-off may find it easier to reduce the asymmetry of interdependence with the former parent by developing new alliances and trading relationships.

Spin-offs from different contexts may also have outcome effects in terms of different spatial spillover effects. In some cases, the spatial spillovers may be local while in others they may be at national and international levels. For example, spinning off consultancy activities from a local university without a critical mass of leading researchers may help stimulate local employment. The use of management buyouts to spin-off smaller divisions of groups located in regions that are undergoing structural transition may enable them to maintain local employment levels. In contrast, spinning off potentially high growth high tech ventures from world leading research universities can enable wider spatial spillover benefits to suppliers and other developers of technology. The economic and social impacts of these spin-offs from different contexts may therefore also differ.

However, these positive social impacts come at a cost. As discussed by Czarnitzki et al. in this issue, the foundation of academic spin-offs imposes social costs in terms of a possible decrease in production and disclosure of academic research. This is in particular relevant if “star” scientists are involved in the foundation process. In the commercial context, the transition of an industry researcher from an incumbent firm to a corporate spinoff may not be related to a decrease in published academic research.

The origin of spin-offs

Nevertheless, if industry researchers leave an incumbent firm this may negatively affect the latter because of, for instance, a loss of capabilities within the incumbent firm's research department or because the corporate spin-off becomes a new competitor. Of course, it may not necessarily be a zero-sum game as the mobility of industry researchers into spin-off firms may create opportunities to recruit new expertise, such as newly qualified graduates from universities or from other countries. Further systematic analysis is needed to explore the impact of different contexts on spillover effects.

5. CONCLUSIONS

In this introductory article, our intention has been to move spin-off studies forward by developing a structured typology that brings together hitherto disconnected but related literatures depicting the rich variety of spin-offs. This has enabled to elaborate a structured framework that forms the basis for further research. As we have shown, the papers presented in this special issue cover only some parts of this typology. We look forward to a resurgence of research in this area that seeks to address outstanding areas and which offers opportunities for the application of different conceptual and empirical approaches.

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