

THESES OF THE DOCTORAL (PhD) DISSERTATION

UNIVERSITY SPIN-OFF COMPANIES AS GAME CHANGERS IN ECONOMIC DEVELOPMENT OF SEMI-PERIPHERAL REGIONS

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1. HISTORY OF RESEARCH, OBJECTIVES AND PRESENTATION OF RESEARCH HYPOTHESES

Since 2011 I have been involved in the study of university spin-off companies and ever since then I have been wondering about the effect that these special type of companies have on the regional economy and to what extent these companies have the possibility to transform the regional economic structure, to make regions more innovative and competitive. In the region where I work and live, a border region in the Eastern Netherlands, this is an important question, which keeps many policy makers busy. The region is called Twente and is a region that is going through extensive restructuring from a typical industrial region in which the textile industry played a major role to a more innovative service oriented region. Over the years I have been building and expanding a longitudinal database of spin-off companies which appeared (and some also again disappeared for various reasons) out of the two major universities in the region, the University of Twente (UT), a research university as well as the Saxion university of applied sciences. In this study I have done several analyses with the dataset to learn how these spin-off companies spatially behave and if the spatial behaviour has consequence for the development of the companies. In other words: Do companies that move out from this border region develop faster than companies that decide to stay within the region.

The question of the regional impact of such university spin-off companies is a much debated one. This academic debate is not in the first place about the goal of spin-off companies: There is a broad consensus in the literature that the goal of a spin-off company is to translate university knowledge into a commercial product or service (Vaessen, 2018). There is much more debate about the question what a spin-off company actually is as there is no broadly agreed upon definition (Mathisen & Rasmussen, 2019; Pirnay, Surlemont, & Nlemvo, 2003; Rothaermel, Agung, & Jiang, 2007). In this study, the definition of a university spin-off is any company that is established by either a (former) student or staff member during study/work or less than 5 years after leaving the institution. One of the reasons why there is so much debate on the definition of spin-offs is that these companies are a very heterogeneous group. Already in 2003, Pirnay et al. (2003) wrote a conceptual paper on the issue in which they proposed to subdivide the population of university spin-offs in a number of subgroups. Even though this idea was adopted by many authors as useful (see for example Bolzani, Rasmussen, & Fini, 2020; Mathisen & Rasmussen, 2019; Rothaermel et al., 2007), to the knowledge of the author, there are currently no empirical studies that explore the differences in spatial behaviour, knowledge links and development of different subtypes of university spin-offs. Perhaps even more surprisingly, there are almost no longitudinal studies available that track the development of university spin-offs over time, an exception being the study of Vaessen (2018), which measures the development of spin-offs at different points in time.

The questions related to the growth and spatial pattern of university spin-offs and the opportunities that (semi-)peripheral regions provide for such companies are hotly debated ones. One line of thought exists which argues that innovation and real economic

development happens almost exclusively in economic core areas, especially in large urban metropolitan areas (Glaeser, 2013; Glaeser, 2022), measurable in the form of origin of patent applications (Boschma & Frenken, 2003; Boschma & ter Wal, 2007), development of entrepreneurial ecosystems (Stam, 2018; Wurth, Stam, & Spigel, 2022), because of unplanned serendipitous meetings (Jacobs, 2016; Marshall, 1920), a large concentration of talent, technology and tolerance (Adler, Florida, King, & Mellander, 2019; Florida, 2002, 2017), or simply (transportation) cost benefits (Weber, 1909). Another line of thought however centers around what has been coined “innovative periphery” by Shearmur (2012). Proponents of this line of thought argue that in many cases economic peripheral locations do not play a passive role in innovation and economic development. It is argued that in more remote areas innovations can develop and grow because of a more shielded environment, far away from the rapid pace of big city life (Eder, 2019; Shearmur, 2015). Being in a more peripheral location means however that after some time many companies with proven successful innovations do feel the need to migrate to larger cities because of the greater availability of capital and workforce (Eder, 2019; Shearmur & Doloreux, 2016). Cities should therefore be seen as the places where innovations are in the first place exploited instead of being developed (Lopes, Gomes, Oliveira, & Oliveira, 2022; Shearmur, 2012).

Given this tantalizing debate on the “birthplace” of innovation, I wanted to study the development of university spin-off companies and understand better their contribution to the so-called regional innovation system, a concept developed by Cooke, Gomez Uranga, and Etzebarria (1997), summarizing how well innovative university spin-off companies could contribute and thrive in a semi-peripheral region like the eastern part of the Netherlands. In other words, I am very curious if university spin-off companies feel that they have enough customers for their innovative technologies/products and services in such a region. Or if not, whether they would show so-called compensation strategies (Eder & Trippel, 2019) when the so-called “absorptive capacity” for innovation of a region would be insufficient (Ávila, 2022), or simply move out to more economic core regions (Bazen, 2018; Van Oort et al., 2008b).

Bringing it all together, the objectives of this study are the following: To contribute to the understanding of the influence that university spin-off companies have on the regional economy of peripheral regions in general and the regional innovation system in particular. As university spin-off companies are a highly heterogeneous group of companies, the group of spin-offs will be subdivided into different subtypes of spin-offs as well as the type of parent institution (research university or university of applied sciences).

This objective leads to the following main research question: In what way and to what extent do different types of university spin-off companies influence the regional innovation system and to what extent could the differences in spin-off types explain the spatial behaviour of these spin-off companies?

To help answer the main research question, this question has been divided into four subquestions:

1. In which way could university spin-offs be defined and what is their importance for the development of the regional economy in their region of origin?
2. What spatial pattern (including migration) can be identified for different types of university spin-off companies from higher education institutions in the eastern part of the Netherlands?
3. Which differences in innovativeness, company development and spatial pattern can be observed for spin-offs from research universities and universities of applied sciences in the eastern part of the Netherlands?
4. To what extent do knowledge and resource links play a role as location factor for different types of spin-off companies from a university in a peripheral region?

These four sub-questions above can be described in more detail as follows:

- *In which way could university spin-offs be defined and what is their importance for the development of the regional economy in their region of origin?*

The question which businesses can be/should be qualified as spin-offs is a much debated one. Based on an extensive literature review, a specific definition is derived which is on the one hand workable (in the sense of measurable) and on the other hand also providing enough meaning in order to be able to understand the specific role of educational interventions or other forms of non-formal entrepreneurship education by universities. The second part of the question deals with the importance of such spin-offs for the regional economy. Importance can be measured on many levels, in terms of jobs created, innovation, social impact or improvement of the general image of the regions. In this study, the choice was made to study the economic impact on the basis of the number of workplaces, as this data is easily measurable and available in governmental databanks. In the research methodology chapter, more information can be found on the specifics of the measurements on this topic.

- *What spatial pattern (including migration) can be identified for university spin-off companies from the eastern part of the Netherlands?*

Discussions in the literature about spatial patterns of spin-offs often describe so-called knowledge spillovers as reasons for such companies to locate in certain places, usually close to the universities they originate from. This study will show the actual longitudinal location pattern of university spin-offs, based on empirical evidence. There are only very few studies that track university spin-offs throughout their lifetime. Some of these university spin-off companies are among the high-tech, high-growth category. It is therefore very interesting to understand how these companies behave spatially. According to the core-periphery theory, there should be a substantial flow of spin-offs from the periphery to more core regions. This research question will therefore contribute to general empirical knowledge of such migration patterns.

- *Which differences in innovativeness, company development and spatial pattern can be observed for spin-offs from research universities and universities of applied sciences in the eastern part of the Netherlands?*

In most of the literature on the subject, there is little attention for the differences within the group of spin-offs. One of the aspects of which spin-offs from higher education institution differ, is whether these spin-offs come from research universities or from universities of applied sciences. As is known from different studies, universities of applied science usually have a more regional profile in terms of student population and industry relations than research universities (Rossano et al., 2023). Therefore, it is likely that the spin-offs that these institutions generate are also different and show a different development and spatial pattern, thus having also different levels of impact on the economy of the region of origin.

- *To what extent do knowledge and resource links play a role as location factor for different types of university spin-off companies?*

This research question deals with the importance of knowledge and resource links in relation to location factors of spin-off companies. Previous research among the general population of Dutch (and other West European) companies has pointed towards an ever increasing importance of so called “soft” location factors, of which the availability of specialized knowledge is part of (Pellenbarg, van Steen, & van Wissen, 2005; Pen, 2000; Rodriguez, 2023; Van Oort et al., 2008). Specific motives for university spin-off companies related to decisions whether to migrate or not are somewhat under researched. Some work on this subject has been done by Egelin, Gottschalk, and Rammer (2004) as well as Avnimelech and Feldman (2015), but an overview of migration motives, and especially the role of knowledge links as migration motive for university spin-offs and if there are significant differences with migration motives of the general population of businesses is missing. There are, to the knowledge of the author, no studies available on specific types of spin-offs and the role that knowledge links play in relation to the spatial pattern for more and less innovative university spin-offs.

The relations mentioned in the research question and sub-questions can be visualized in a conceptual model (Figure 1) based on the influential model of an ideal-type regional innovation system of Cooke and Piccaluga (2004). Since university spin-offs are by

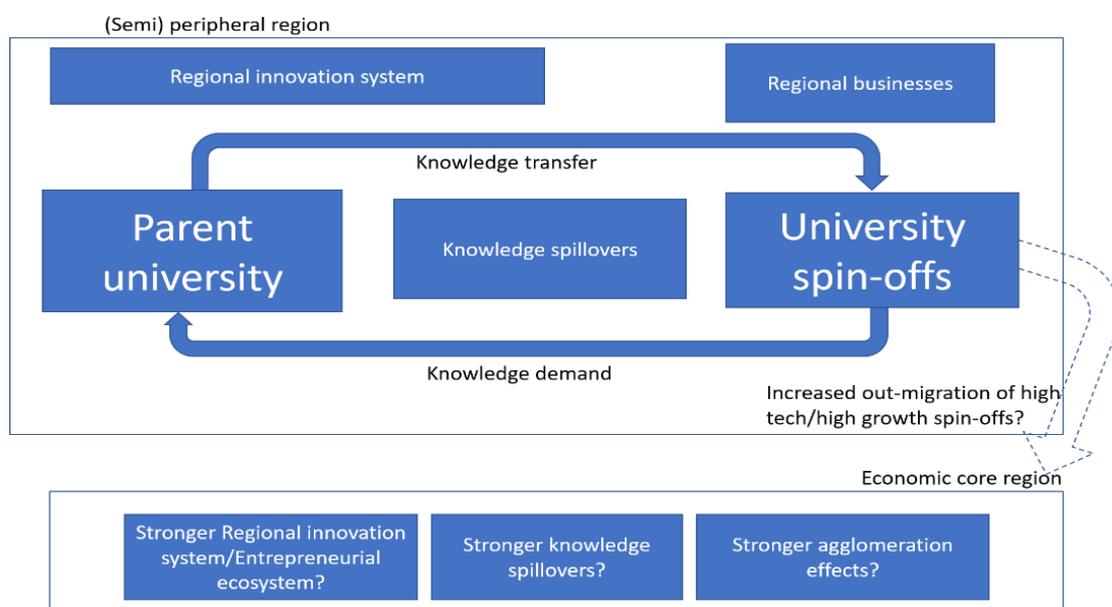


Figure 1: Conceptual model based on the Regional Innovation System model of Cooke and Piccaluga (2004)

definition companies that work on the “translation” of university developed knowledge into actual business, this regional innovation system model is useful to show the knowledge relations between parent university and spin-off. The original model assumes that knowledge links between universities and businesses are key determinants of regional innovation systems, supported and/or enhanced by regional “assets” such as relevant business clusters. In the adapted conceptual model, the regional innovation ecosystem in a semi peripheral region, experiences influences from economic core regions. These influences pull on university spin-offs, especially the ones with ambitious entrepreneurs, aiming for company growth. It is expected that a larger number of high tech/high growth companies will leave the region of origin.

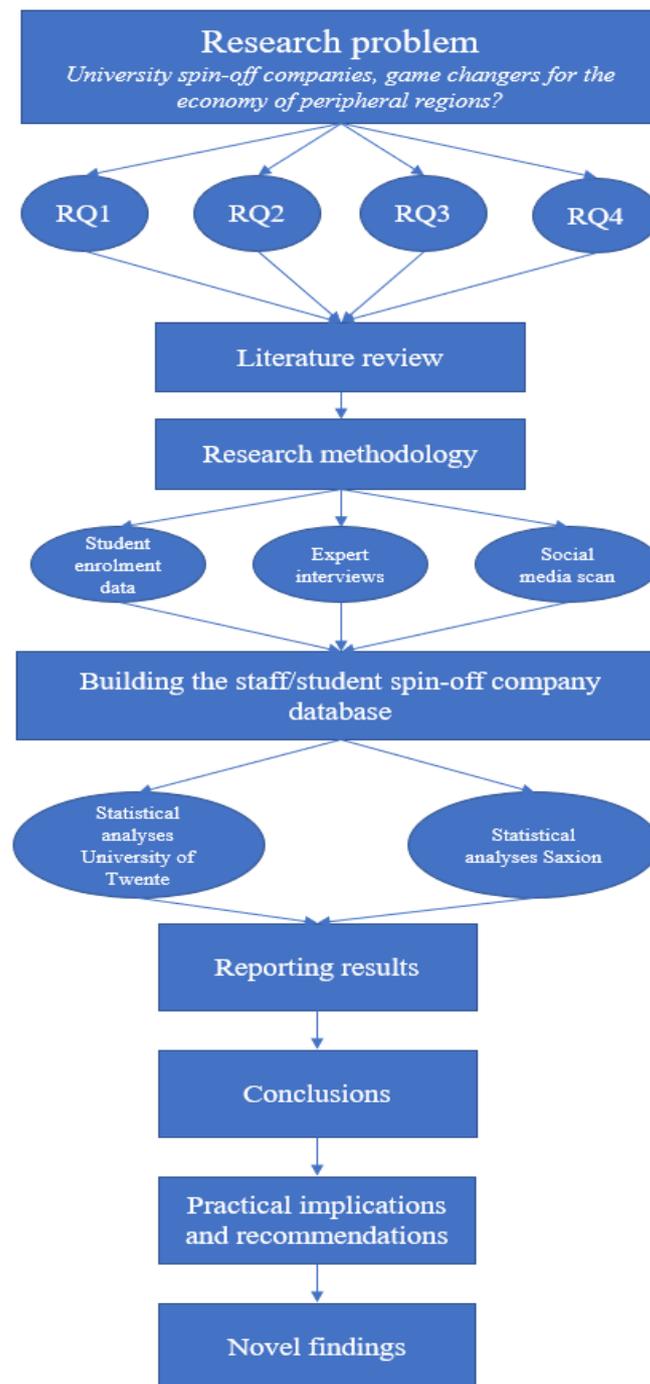


Figure 2: The research process scheme

The study has been set up following the research process scheme displayed in Figure 2. The basis of the study is the research problem identified earlier in this introductory chapter, leading to four research questions. The next step was to perform a literature review to understand the current developments in university spin-off research and to establish which empirical data still needs to be collected, i.e. where the “gaps” in the literature are located. This study consists of a database in which spin-off companies are collected. The methodology of collecting the data consists of using student enrolment data to find out whether they are already entrepreneur, a social media scan to find students and staff members with their own business and expert interviews with business developers from the university business incubator. The details of the methodology can be found in chapter 2. Since the spin-offs from the two universities in the study are statistically significantly different, the findings and corresponding statistical analyses have been done separately for the University of Twente and Saxion. Chapter 3 reports the main findings of the study and chapter 4 and 5 deal with the practical implications and the discovered novel findings respectively.

2. DESCRIPTION OF THE DATABASE AND THE METHODS USED

The empirical part of this study consists of the construction of a database in which all qualifying university spin-off companies that have been identified are included. The database consists of an entry for every year that the company exists, up to 2021 or until the year the company is dissolved for whatever reason. This approach leads to a database in which not just the development of companies in terms of workplaces can be seen, but also gives insight into the spatial development of the spin-offs, in the sense of whether these companies migrate or not and about their development in terms of number of employees before and after migrating.

Finding as many qualifying spin-offs as possible is a challenging task, not in the last place because Saxion and the UT are both large Higher Education Institutions (HEIs) with around 27.000 students/2800 staff and 11.000 students/3100 staff respectively. Since spin-offs appear from different origins, from staff members or students, with a lot or very little influence from the parent university, it is therefore necessary to use different ways to acquire data. The data collection methods for this study are rather straightforward, but very labour intensive. Spin-offs in this study have been found with the help of three main data collection methods:

1. The UT/Saxion student entrepreneurship monitor
2. Social media (LinkedIn) searches
3. Interviews with business developers/other experts

When a university spin-off has been identified by any of these three above methods, the Dutch trade register is consulted, to see whether this specific company is legally registered. The REACH database of Bureau Van Dijk is used for this, as it offers a complete overview of all registered businesses in The Netherlands (Bureau Van Dijk, 2017). Since Novel-T also offers trainings to nascent entrepreneurs, usually there is a delay in having followed a training and the actual legal registration of a business. The names of these legally soon-to-appear spin-offs are saved in a special list of “prospect companies”, to be checked again in the next round of updates. In the REACH database also ownership of the spin-off can be found, so it is possible to confirm the link between entrepreneur and company.

Both Saxion and the UT ask all students during the yearly (re) enrolment procedure in any of their academic programs whether they are interested in starting their own business, or if they already have their own business. The question is asked via the central Dutch enrolment platform “studielink.nl”, where individual universities have the option to adjust the questions asked slightly. Both HEIs have added the question “Do you consider starting your own business?” to the enrolment platform. Answers given can be: Not at all, maybe, „yes, after my study”, „yes, during my study” or “I already have my own business”.

The “studielink” question delivers the names of the students who answered “I already have my own business”. A subsequent social media search is done to find out the company name

of this student and possible further details. The third step is to find out from the Bureau Van Dijk REACH database whether the business has been legally registered. In case the company is officially registered, it is included in the study. If it is not registered, it is added to the list of “prospect companies”, which is re-checked in the next round of updating the database.

This data collection method has the advantage that all students of both HEIs are asked about their own status as entrepreneur. Even though several additional steps need to be taken (social media search and REACH database check), this method yields a lot of qualifying start-ups. Of course not all student entrepreneurs choose to continue their company after graduation, but a significant amount of them does. Likewise, not all recent graduates already start their business while being a student. According to the definition used in this study (see chapter 2.2.2), all start-ups that are established less than five years after the entrepreneur leaves the UT/Saxion qualify as a spin-off. Therefore, this method alone will not find all qualifying spin-offs and needs to be complemented by other data collection methods.

Besides data from the UT/Saxion on student entrepreneurship, data on spin-offs is also collected by doing a wider social media scan. In the Netherlands, LinkedIn is the most popular professional public platform to publish one’s curriculum vitae, and has around 7.8 million users in the Netherlands (Marketingfacts, 2020), about 40% of the total population. Given the fact that LinkedIn is so often used, especially within the target group of entrepreneurs/business owners, even if it is just for publishing a public C.V., it is the most likely place to find qualifying spin-off entrepreneurs.

On LinkedIn, the search terms in the job description: “entrepreneur”, “founder” and “owner” as well as their Dutch equivalents “ondernemer”, “oprichter” and “eigenaar” are used in combination with having had an education at the UT/Saxion. The search results are then manually filtered to exclude those who started a business more than 5 years after leaving the university. Just like with the data from the “student entrepreneurship” re-enrolment question, the collected data is fed into the REACH Bureau Van Dijk database to find out whether this business has been officially registered. If not, the data is added to the list of “prospect companies”, which is re-checked in the next round of updating the database.

The strength of this method is that it is possible to find with a rather large degree of reliability (because of such a high percentage of users) many qualifying spin-offs. The disadvantage is that the results are dependent on the entrepreneur having his/her own profile in LinkedIn and the willingness to share this information to the wider public. In several cases, incomplete LinkedIn profiles (e.g. without graduation year/years of employment and/or year of establishment of their own business) can lead to exclusion of potential qualifying spin-offs. To minimize the risk of excluding companies that actually qualify, one more data collection method is used to find additional spin-offs, namely interviewing business developers/other experts.

To complement the data from the “Studielink” student entrepreneurship question and the Social Media (LinkedIn) scan, also several UT/Saxion business developers are interviewed, and shown the list of newly found enterprises, to understand whether they know of some additional businesses started either by staff or students that they worked with, and have not been included in the results so far.

Also here, the data collected via this method is fed into the Bureau Van Dijk REACH database, to check whether the company is legally registered. Information of business developers leads relatively often to the identification of entrepreneurs who are in the preparation phase of starting their business. Such nascent entrepreneurs are then added to the “prospect companies” list, to be re-checked in the next update of the database.

The resulting database with UT/Saxion spin-off companies is updated on a yearly basis. Every year new companies are added and for the already existing companies a new entry is added with information from the Bureau Van Dijk REACH database. The following aspects of any company are available and added to the database every year:

- Chamber of Commerce identification number (serving as a unique identifier for any company in the database)
- Name of the firm
- The main sector of activity (according to the Dutch SBI2008 classification system, based on the international NACE/ISIC systems)
- Number of employees
- Location of the company (Dutch postal code)
- Year of establishing the company
- Name of the entrepreneur (not always available)
- Gender of the entrepreneur (not always available)
- (If applicable) year of dissolution of the company
- (If applicable) reason of dissolution of the company
- (If applicable) merger/acquisition

Financial data is only sparsely available within the REACH database, therefore indicators such as turnover, investments and profit are not included in the research database, since only a limited number of spin-offs have the obligation to report such data. Number of employees is much more widely available and serves in this study as a proxy for company size. Since the database is longitudinal by nature, development of each of the company aspects can be monitored over time. The name of the company and the main sector of activity only seldom change. Number of employees is reported yearly and can therefore be used accordingly. The location of companies is updated on almost real-time basis, and can also be used in yearly reporting, as it is unlikely that companies move multiple times per year.

Therefore, the yearly collected data of these spin-off companies forms a longitudinal study into their development in mostly two areas: the company size in number of employees and

their location. Based on the variables stated above, including combinations of these, many different analyses can be done.

When spin-off companies are dissolved, no extra entries are added and data collection for that company stops. In case of the original entrepreneur selling the company, data collection will continue, but a special flag variable will be activated, that this company is no longer under control of an entrepreneur who meets the criteria for having a spin-off.

3. THE MAIN FINDINGS OF THE THESIS

As the UT and Saxion, the two HEIs in focus of this study, have different profiles, respectively research university and university of applied sciences, large differences in the types of spin-offs as well as their development and spatial pattern can be expected.

Group Statistics					
	Parentorganization	N	Mean	Std. Deviation	Std. Error Mean
SpinOffSize	University of Twente	793	35.54	563.305	20.004
	Saxion UAS	1591	5.95	56.640	1.420

Independent Samples Test									
		Levene's Test for Equality of Variances				t-test for Equality of Means			
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference
						One-Sided p	Two-Sided p		
SpinOffSize	Equal variances assumed	13.010	<.001	2.075	2382	.019	.038	29.593	14.262
	Equal variances not assumed			1.476	799.992	.070	.140	29.593	20.054

Independent Samples Effect Sizes					
		Standardizer ^a	Point Estimate	95% Confidence Interval	
				Lower	Upper
SpinOffSize	Cohen's d	328.094	.090	.005	.175
	Hedges' correction	328.198	.090	.005	.175
	Glass's delta	56.640	.522	.435	.610

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure 3: Independent samples T-test showing the significant differences between the two populations of university spin-offs

I have chosen to deal with spin-offs from the UT and Saxion in separate sections, because they are quite different from each other. An independent (one-tailed) T-test on the economic impact of spin-offs in terms of the size of the spin-off companies in terms of number of workplaces from both institutions (Figure 3) shows that UT spin-offs have a significantly larger size (Mean: 35 workplaces, St.dev: 563.3) and therefore impact than Saxion spin-offs (Mean: 5.5 workplaces, St. dev: 56.6), $t(2382)=2.08$, $p=.019$. Reporting the results of the spin-offs of the two universities together would therefore significantly lower the quality of the conclusions. Therefore, chapter 3.1 deals with UT spin-offs and chapter 3.2 with Saxion spin-offs.

3.1. UT Spin-offs

The UT was established in 1962, but strong attention for entrepreneurship only started in the 1980s, within the university policy. Given this situation, as well as the fact that the results of the university policy to support entrepreneurship took some time to be actualized, there are only few spin-offs from before 1990. At the time of writing, there are 1286 spin-off companies identified, of which 722 are still commercially active (see Table 1).

Table 1: Development of the number of UT spin-offs

Year of establishment	Cumulative number of established spin-offs	Cumulative number of commercially active spin-offs in 2021
2005 and earlier	505	283
Until 2010	816	446
Until 2015	1171	639
Until 2021	1286	744

Source: Own compilation

All spin-offs of the UT have also been classified according to the typology of Pirnay et al., among them are 53 spin-offs of Type I, the spin-offs with codified intellectual property. This is just a small number of the total amount of spin-offs, as could be expected because of the narrow definition. Type II, the research based spin-offs (with more tacit knowledge transfer), consists of 167 spin-offs. The group Type III, the entrepreneurial ecosystem supported spin-offs, consists of 525 spin-offs and the remaining Type IV, the student start-ups, consist of 541 spin-offs. Adding the numbers of the four types, gives 1286 as the total number of identified spin-offs.

Table 2 shows an overview of the different types of spin-offs, including the currently commercial active ones.

Table 2: Number of UT spin-offs per spin-off type in 2021

Type of spin-off	Total number identified in 2021	Commercially active in 2021
Type I	53 (4%)	38 (5%)
Type II	167 (13%)	95 (13%)
Type III	525 (41%)	296 (40%)
Type IV	541 (42%)	315 (42%)
Total	1286 (100%)	744 (100%)

Source: Own compilation

In terms of the development of workplaces in spin-offs, the UT spin-offs count for about 28000 workplaces in the Netherlands (see Figure 4). It is however important to add a few notes to these results. In the first place, the Dutch trade register is not very accurate, especially for micro sized companies (less than 10 employees). Secondly, around three quarters of all workplaces in spin-offs are formed by two outliers, namely Booking.com (around 15000 employees registered in The Netherlands) and Just eat/Takeaway.com (around 3000 employees registered in The Netherlands). The large jump in employment in spin-offs in 2019 is caused by a large administrative transfer of jobs to the Netherlands by Booking.com. The third issue is connected with the second one, in the sense that only jobs registered within The Netherlands are counted, leading to an underestimation of the total amount of workplaces generated worldwide. Nonetheless, for the question of the development of the regional innovation system in the Eastern Netherlands, these three issues

related to employment do not strongly influence the results and conclusions. The number of jobs per spin-off type shows that the type I spin-offs account for the lowest number of workplaces and type IV for the most (see Table 3). As predicted by Bolzani et al. (2020), type I spin-offs with their usually very close links to the parent institution, being the most

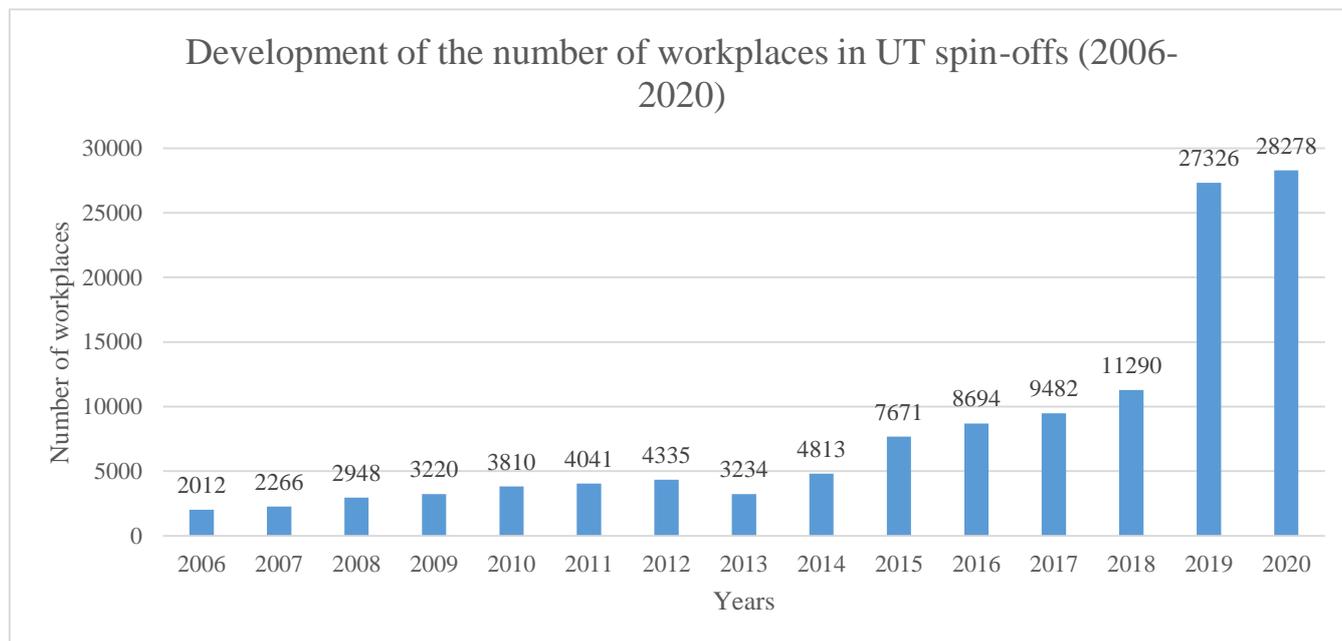


Figure 4: Development of the number of workplaces in UT spin-offs

high tech spin-offs around, such intense knowledge links could actually hinder the commercial development (i.e. company growth) of such spin-offs.

Table 3: Number of workplaces per spin-off type

Spin-off type	Total number of workplaces in 2020
Type I	294
Type II	1286
Type III	3201
Type IV	23497

Source: Own compilation

Type IV spin-offs offer by far the largest amount of workplaces, and are spin-offs that have not received a lot of formal support from the entrepreneurial ecosystem around the UT. It is however good to note again that the large number of the type IV spin-offs is caused by a few very large companies that fall into this category. The majority of the type IV companies stay very small, and are only sole proprietor firms. None of the other spin-off types have such a high percentage of sole proprietors. So, paradoxically type IV spin-offs are the largest when looking at the arithmetic mean, as well as the smallest, having the largest percentage of sole proprietors (see Table 4). This finding partially confirms the observations of Harrison and Leitch (2010) that many of these student start-ups are likely “lifestyle companies”, more than firms aimed at growth and scaling-up.

Table 4: Percentage of sole proprietor entrepreneurs per spin-off type

Spin-off type	Percentage of sole proprietors	Median company size in number of workplaces
Type I	47%	2
Type II	39%	2
Type III	46%	2
Type IV	55%	1

Source: Own compilation

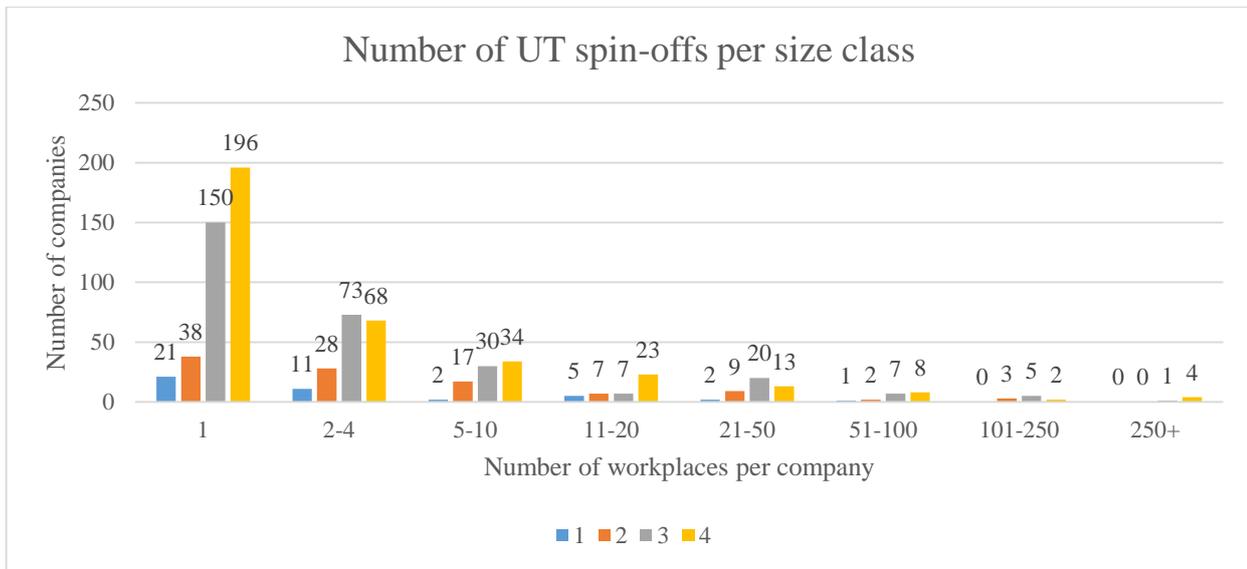


Figure 5: Number of UT spin-offs per size class (in number of workplaces)

Figure 5 gives a better understanding of the extreme skewedness of the size distribution of the different spin-offs, per spin-off type. It can clearly be seen that only very few spin-offs do not fall in the category of SME business (1-250 employees, according to the EU definition). Still, these five companies offer in total more than 20 000 workplaces, showing that in rare cases (the so-called unicorn cases), spin-offs can indeed become very large companies which could have a large impact on employment within a region, providing that such spin-offs will stay in the region of the parent university.

3.2. Saxion spin-offs

Saxion has an almost similar database available as that of the UT, for its spin-offs. The two most important differences between the databases is that in the case of Saxion, 1. no further subdivision among the spin-offs is made and 2. that detailed spin-off information is only collected since 2016. Spin-offs of the UT are categorized in four subtypes, but the spin-offs from Saxion not. This is because Saxion is a university of applied sciences with more practical study programs and also spin-offs from Saxion tend to be lower tech than the ones from the UT. This means that there are only very few spin-offs in type I and II, and most would be in type III and IV. There is however a lack of data within Saxion about spin-offs that have gotten ecosystem support, therefore the division into spin-off types cannot be made.

Saxion exists already longer than the UT, and its origins can be traced back to at least the 19th century, however, entrepreneurship support policy at Saxion only took off in the second half of the 1990s, with the establishment of the Small Business & Retail Management study program and shortly after that the Saxion Kenniscentrum voor Innovatief Ondernemerschap (SKIO), later renamed to Saxion Centre for Entrepreneurship (Van der Velde, personal communication, 2021), almost two decades later than at the UT. Therefore, the number of Saxion spin-offs in 2006 starts off lower than those of the UT, but given the much larger size of Saxion in numbers of students, it is logical that the number of spin-offs grows faster than those of the UT (compare Table 1 with Table 5).

Table 5: Number of Saxion spin-offs established

Year of establishment	Cumulative number of established spin-offs	Cumulative number of commercially active spin-offs
2005 and earlier	282	211
Until 2010	759	463
Until 2015	1346	821
Until 2020	1589	1037

Source: Own compilation

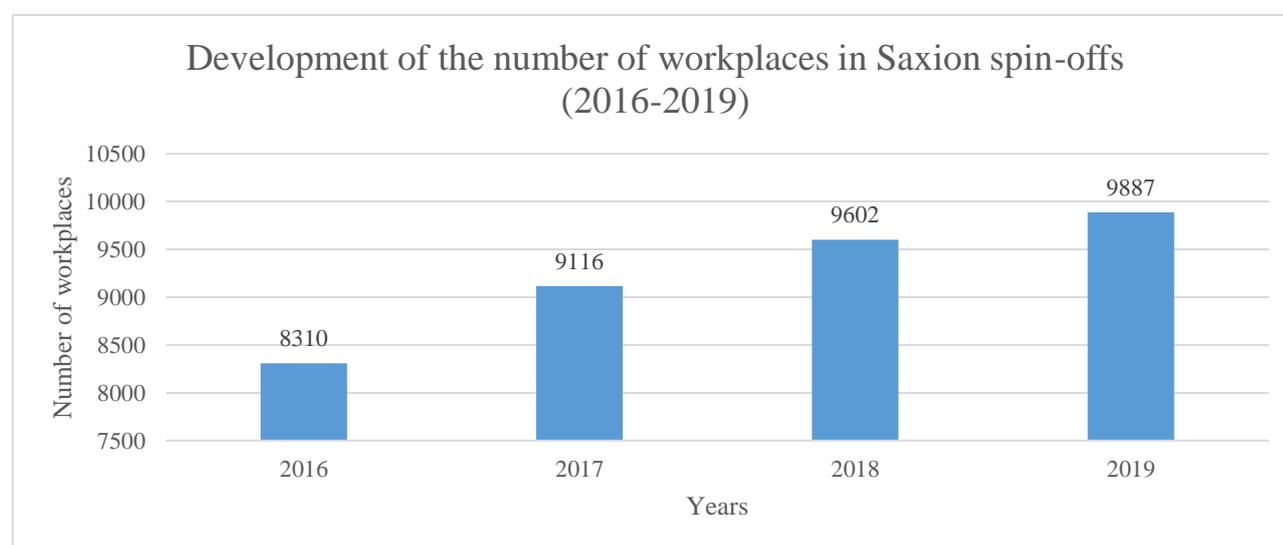


Figure 6: Development of the total number of workplaces in Saxion spin-offs

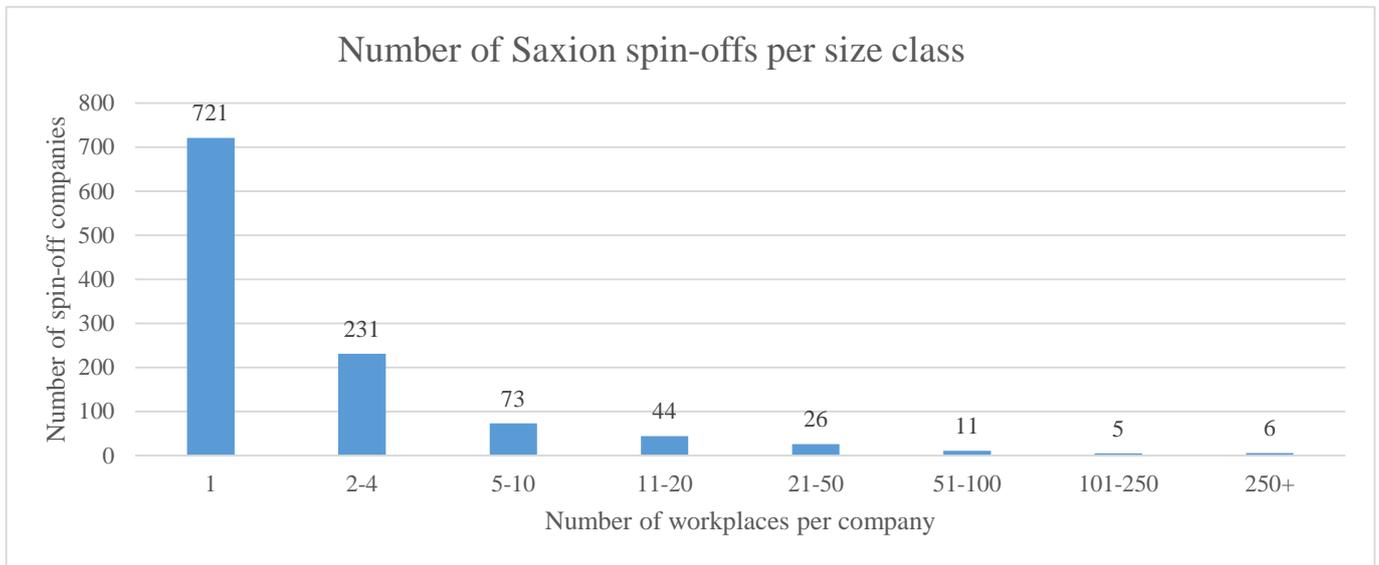


Figure 7: Number of Saxion spin-offs per size class (in number of workplaces)

Figure 6 shows that the number of workplaces in Saxion spin-offs counts to 9887 in the Netherlands in 2019. Just like with UT spin-offs, this is an underestimation of the total number of workplaces in Saxion spin-offs, because no spin-offs located outside of the Netherlands are taken into account. But as with the UT spin-offs: important for this study is the influence of these spin-offs on the innovation ecosystem in the Eastern part of The Netherlands. Therefore, missing out on the international effects of the universities is an acceptable shortcoming. As written before, the Saxion spin-offs cannot be divided into different subtypes, but in general the development of the employment can be measured and is visible in Figure 6. An important notice here is that there are no reliable specific employment data from before 2016 available, therefore this graph covers only the time period 2016-2019.

Just like the employment in spin-offs in the UT, the division of workplaces over the Saxion spin-offs is very skewed. A large percentage of them consists of sole proprietors (63.5%), a considerably larger number than at the UT spin-offs. Many more spin-offs are only micro-sized: Only a handful of spin-offs offer more than 250 workplaces, which means that more than 99% of them are SMEs. Figure 7 shows an overview of the size classes of Saxion spin-offs.

3.3. Location of UT spin-offs

Figure 8 shows the percentage of all identified spin-offs of each UT spin-off type, located in Enschede, Twente, Eastern Netherlands and the total for The Netherlands, which is by definition 100% as no foreign based spin-offs are included in the study. From the type I spin-offs, more than two thirds is located in the municipality of Enschede, and four out of five in the eastern part of the Netherlands. By contrast, from the spin-offs without any formal regional ecosystem interventions, the type IVs, only 25% is located in Enschede and 59% located in the eastern part of The Netherlands. In total, for all UT spin-offs, the percentage of spin-offs located in Twente is 54% and for the eastern part of the Netherlands 68%. This

last percentage is significantly lower than for the Saxion spin-offs, which is something not completely unexpected, because Saxion has a more regional orientation and relatively more students from the eastern Netherlands than the UT (Bazen, 2020).

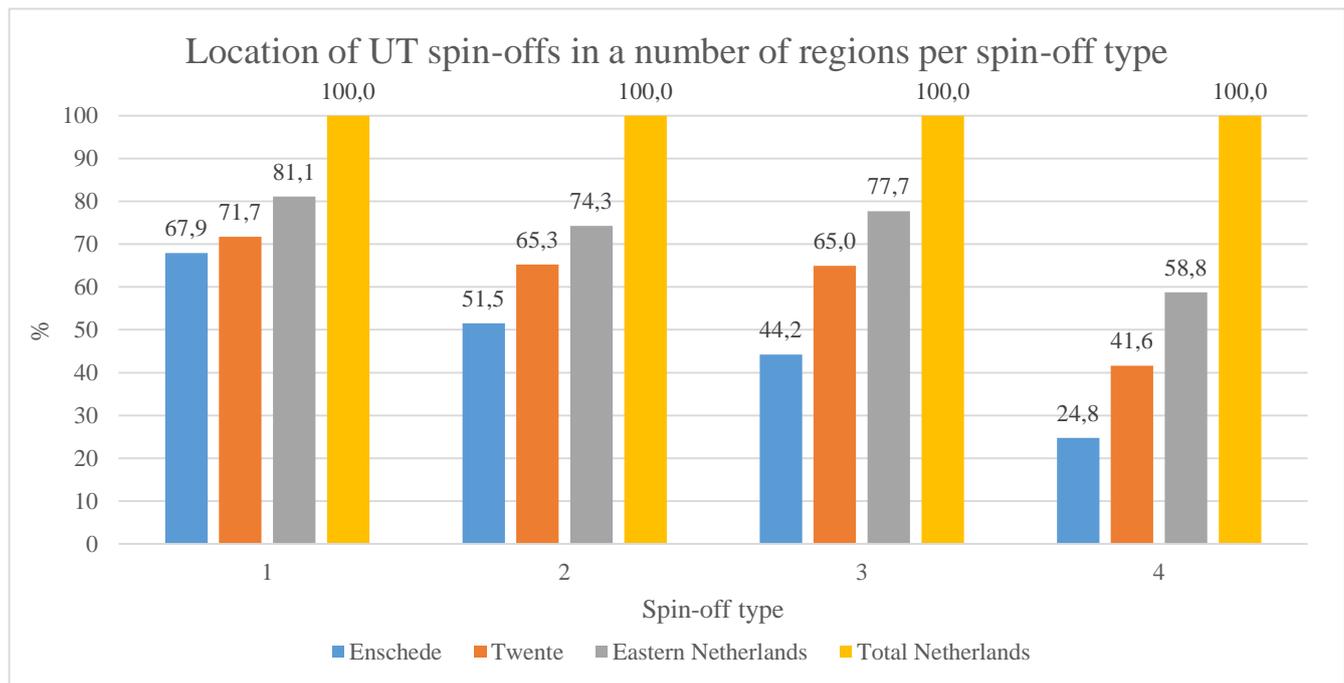


Figure 8: Percentage of all identified UT spin-offs per spin-off type, located in a number of regions in The Netherlands

An independent samples T-test (one-tailed) with the spin-off type as independent variable and the distance in kilometres to the parent university as dependent variable (Figure 9) shows a significant difference in distance to the parent university between the two groups of spin-offs. The most innovative spin-offs (Type I) can be significantly found closer to the university (Mean distance: 37.5km, Standard deviation: 61.2) than the other spin-off types (Mean distance: 63.1km, Standard deviation: 69.4). The T-test t value (df=1274) equals 2.62, with a p value of .004.

Spin-Off-Code		N	Mean	Std. Deviation	Std. Error Mean
Distancetoparent	>= 2	1224	63.118	69.4050	1.9838
	< 2	52	37.454	61.2446	8.4931

		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Significance One-Sided p	Significance Two-Sided p	Mean Difference	Std. Error Difference
Distancetoparent	Equal variances assumed	8.766	.003	2.623	1274	.004	.009	25.6643	9.7834
	Equal variances not assumed			2.943	56.710	.002	.005	25.6643	8.7217

		Standardizer ^a	Point Estimate	95% Confidence Interval	
				Lower	Upper
Distancetoparent	Cohen's d	69.0969	.371	.093	.649
	Hedges' correction	69.1376	.371	.093	.649
	Glass's delta	61.2446	.419	.128	.706

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure 9: T-test about the differences in distance based on the type of spin-off

A simple linear regression to predict the distance to the parent university based on the spin-off type was calculated (Figure 10). A statistically significant regression equation was found ($F(1,1274) = 50.343$, $p < .001$, with an R^2 of 0.038. The predicted distance is equal to $9.091 + 16.513$ (per spin-off code) measured in kilometres. The predicted distance increased with 16.513 kilometres for each subtype of spin-off (1 = most innovative to 4 = least innovative).

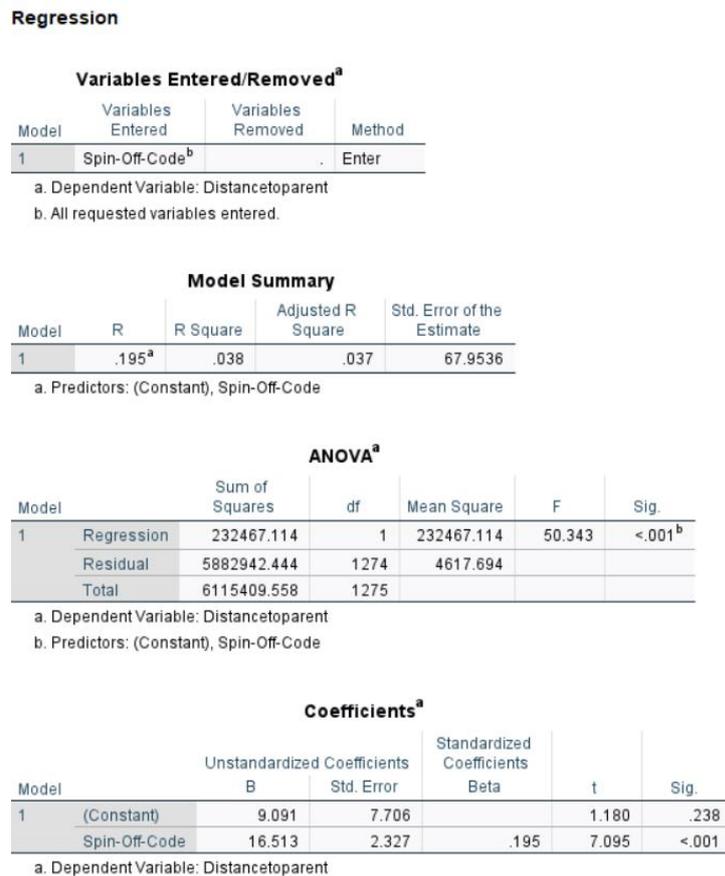


Figure 10: Simple regression model about the prediction of the average distance to the parent university based on the spin-off type.

Since the municipality Enschede has by far the largest concentration of UT spin-offs, it is useful to look at the data of neighbourhoods within Enschede, to find out in which parts of the city the spin-offs are actually located. Figure 11 shows a map of the location of UT spin-offs within Enschede. Even on this small geographic scale level, there are large differences between different neighbourhoods in terms of location of spin-offs. Not surprisingly, by far the largest concentration of spin-offs (100+) can be found in the Kennispark area (the business & science park). Other areas of spin-off concentrations are the UT campus area itself, the Enschede city centre and the Roombeek area, which was largely destroyed in the 2000 Enschede fireworks disaster and rebuilt afterwards. This new neighbourhood houses now a cluster of IT companies (Bazen, 2014), many of which are UT spin-offs. It is surprising to see how few spin-offs are located in most of the other neighbourhoods of Enschede, including several larger industrial zones. Apparently, there are large

“agglomerative forces” active, even on a local scale, which results in the current concentration of businesses.

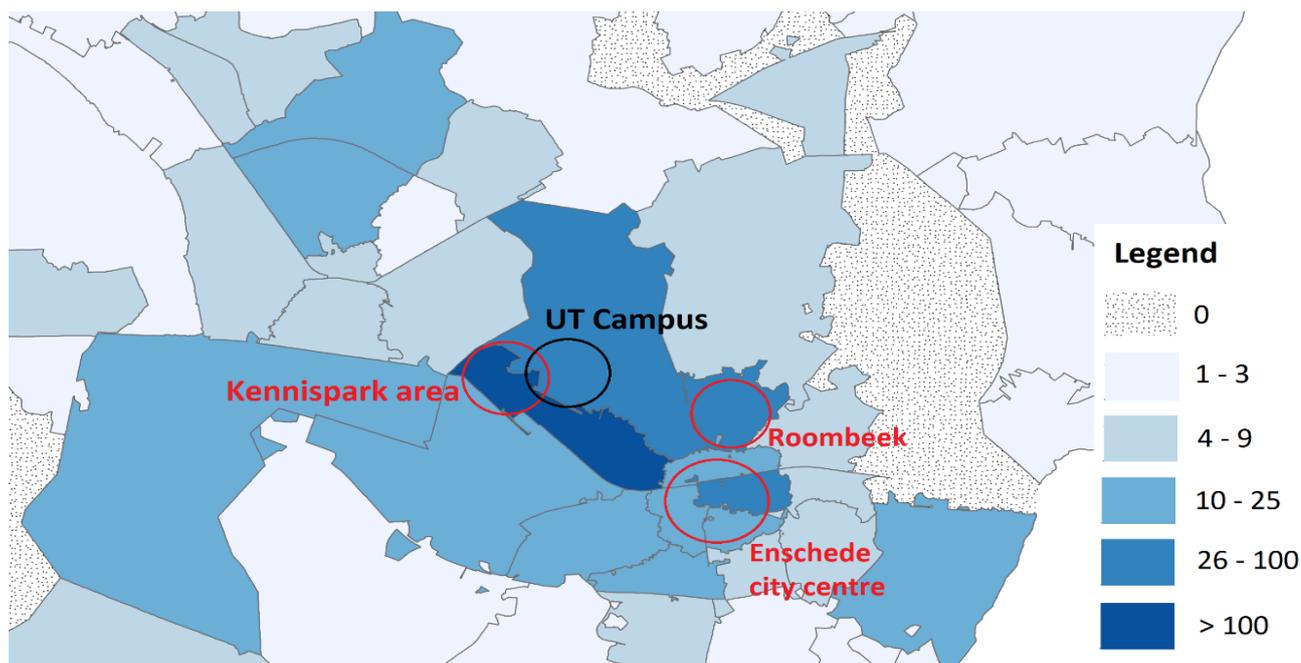


Figure 11: Location of UT-spin off companies within the municipality of Enschede

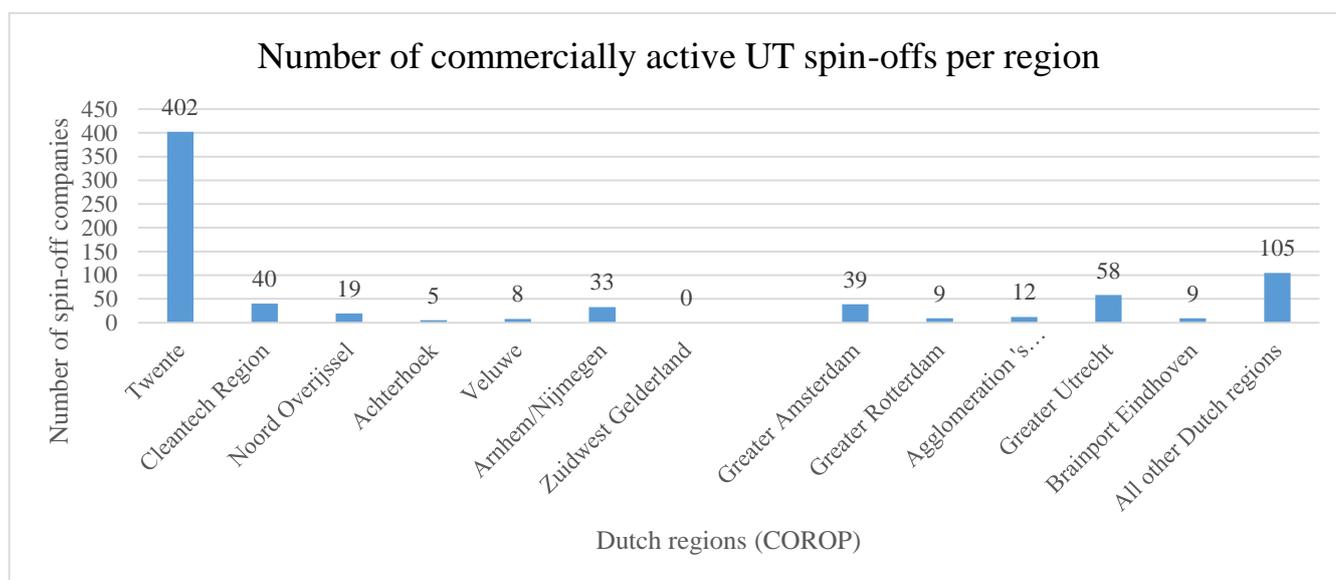


Figure 12: Number of commercially active UT spin-offs in 2020 per region

Even though many spin-offs are located in the region Twente, there are several more located in the wider area of the eastern Netherlands (provinces Overijssel and Gelderland) and also in the rest of the country. Figure 12 shows the number of UT spin-offs in other regions of the Netherlands. The left part of Figure 12 shows the number of commercially active UT spin-offs in the different sub-regions of the eastern Netherlands. The right part of this figure shows the number of commercially active spin-offs in the five largest agglomerations in The Netherlands. All other Dutch regions, not being in the eastern Netherlands or the five largest agglomerations, are on the far right column of the figure.

3.4. Location of Saxion spin-offs

Saxion has its main campus in Enschede, but also two smaller campuses in Deventer and Apeldoorn. Therefore, it is expected that spin-offs from Saxion will be a bit more spread over the Eastern part of the Netherlands than the UT spin-offs, not in the last place because Saxion is a university of applied sciences, with a strong regional focus: The “market share” of Saxion among the secondary school leavers in the region Twente, who chose to study in an applied science study program, is around 70% (Bazen, 2020). That probably also means that it is more likely that they will be more concentrated in this part of the country and less spread out in different regions. For reasons of easy comparison, the same regional division has been used for Saxion spin-offs as for the UT spin-offs. Just like with the UT spin-offs, many Saxion spin-offs are located in Enschede, although it is also clearly visible that the Saxion spin-offs are more spread out over the region and are also located in the more rural areas of the region (Figure 13).

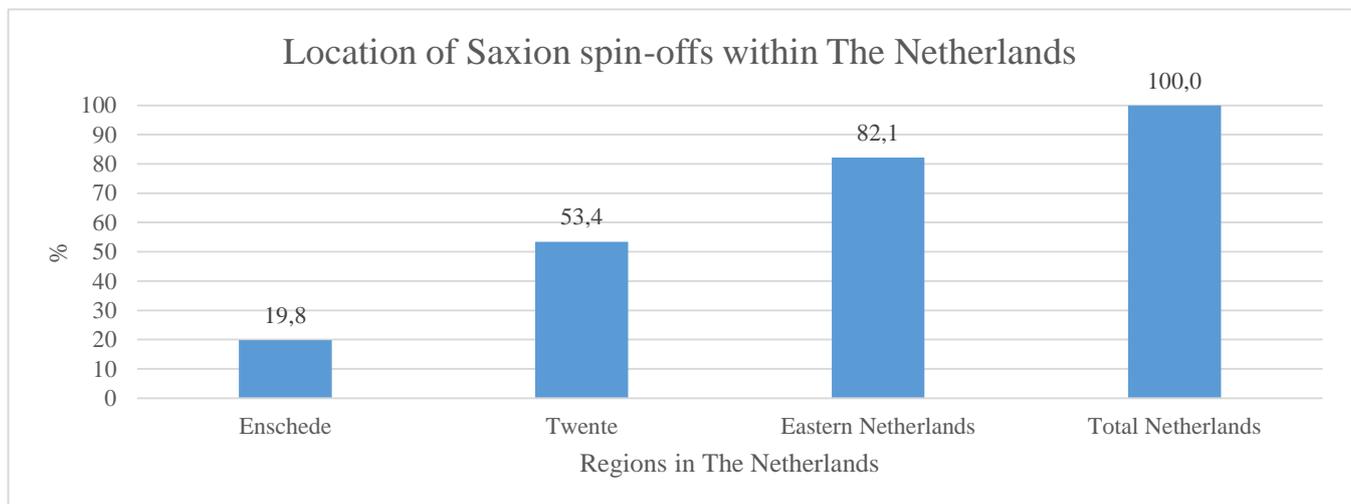


Figure 13: Location of commercially active Saxion spin-offs in 2019 (in %)

Since so many Saxion spin-offs are located in the municipality Enschede, it is useful to analyse just like with the UT spin-offs, which locations within Enschede are especially attractive for spin-offs. When looking at the Saxion spin-off locations in Figure 14, several similarities and differences with the UT spin-offs are visible. For comparison reasons, the same class boundaries are used for both UT and Saxion spin-offs, making the concentration and dispersion of spin-offs better visible and comparable between the two institutions. Just like for UT spin-offs, there is a concentration of Saxion spin-offs in the Kennispark area. However, this concentration is much lower for Saxion spin-offs. Other similar spin-off concentrations are to be found in the Roombeek neighbourhood and to a lesser extent in the city centre. Saxion spin-offs are more likely to be located in the city centre than UT spin-offs (probably because Saxion itself is located there). Another concentration of Saxion spin-offs can be found in the Stadsveld/Bruggert neighbourhood. In comparison with the UT, Saxion spin-offs are much less concentrated in a few neighbourhoods within Enschede.

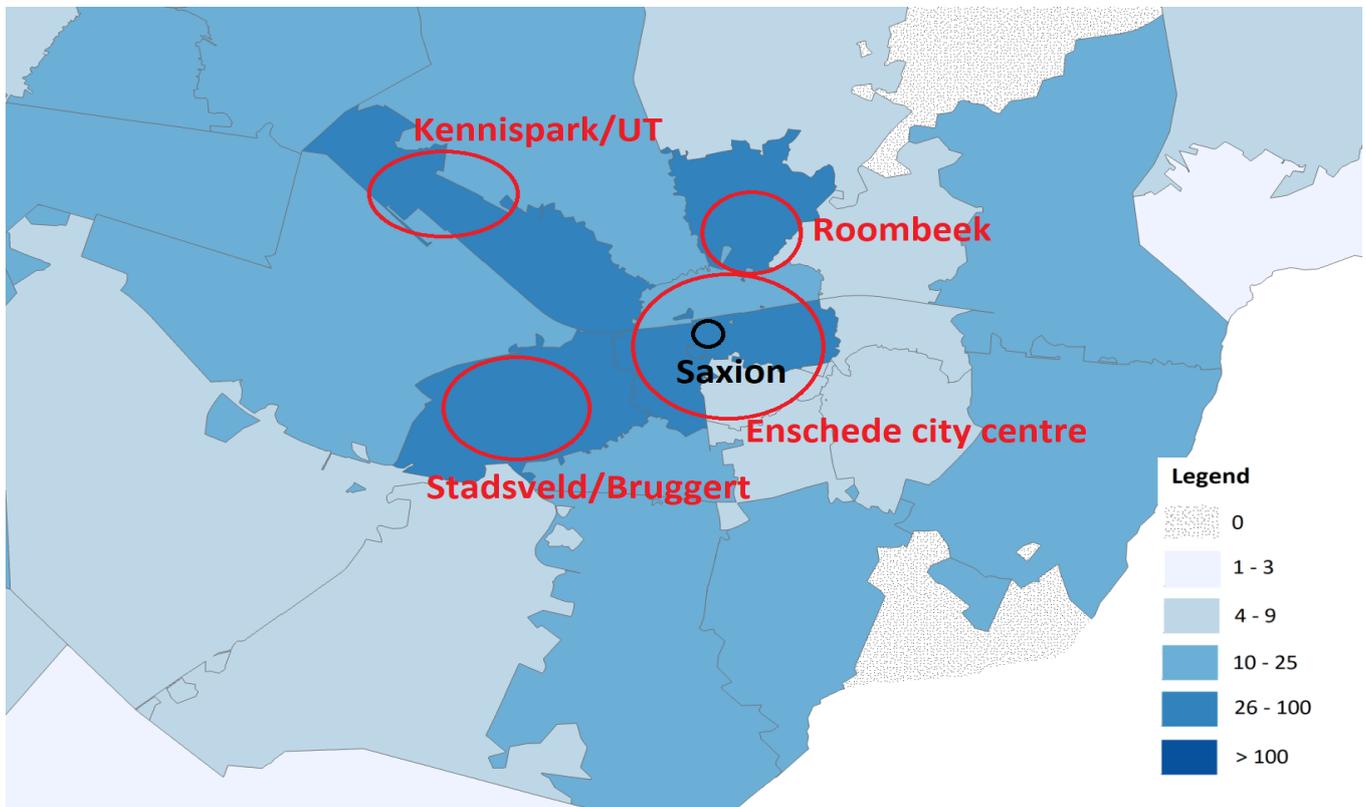


Figure 14: Location of Saxion spin-offs within the municipality Enschede

Just like the UT spin-offs, there are also Saxion spin-offs registered outside the region Twente. A striking difference with the location of the UT spin-offs is that less Saxion spin-offs are located in Enschede itself, but at the same time, more of them are located in the eastern Netherlands. This is a somewhat expected outcome, given the strong regional focus of the university in terms of origin of its students. The lower percentage for spin-offs located in Enschede itself, means that it appears that many Saxion spin-offs do not see profit in having a close geographical proximity to Saxion. As written before, Saxion has two other (smaller) campuses in Deventer and Apeldoorn. Compared to Enschede (where 19.8% of all active Saxion spin-offs are located), in Deventer (5.7%) and Apeldoorn (2.8%) an even smaller number of spin-offs are located.

This is also the case in the entire Cleantech Region, in which both Deventer and Apeldoorn are located, as can be seen on Figure 15: Based on the findings on proximity in the literature (see chapter 1), it would be expected that a larger number of Saxion spin-offs would be located in the Cleantech Region as well as a larger employment in these spin-offs. The entrepreneurship support policy of Saxion is similar for all three campuses, yet it appears that in Twente many more and larger spin-offs are generated. The most important reason for this is likely that the Saxion spin-offs in Twente could already make use of the existing Novel-T/Kennispark Twente ecosystem, built before by the UT. In the Cleantech region, Saxion needed to start completely from scratch and has not yet been able to find enough connection with other available entrepreneurship support structures in the region (Van der Velde, personal communication, 2021).

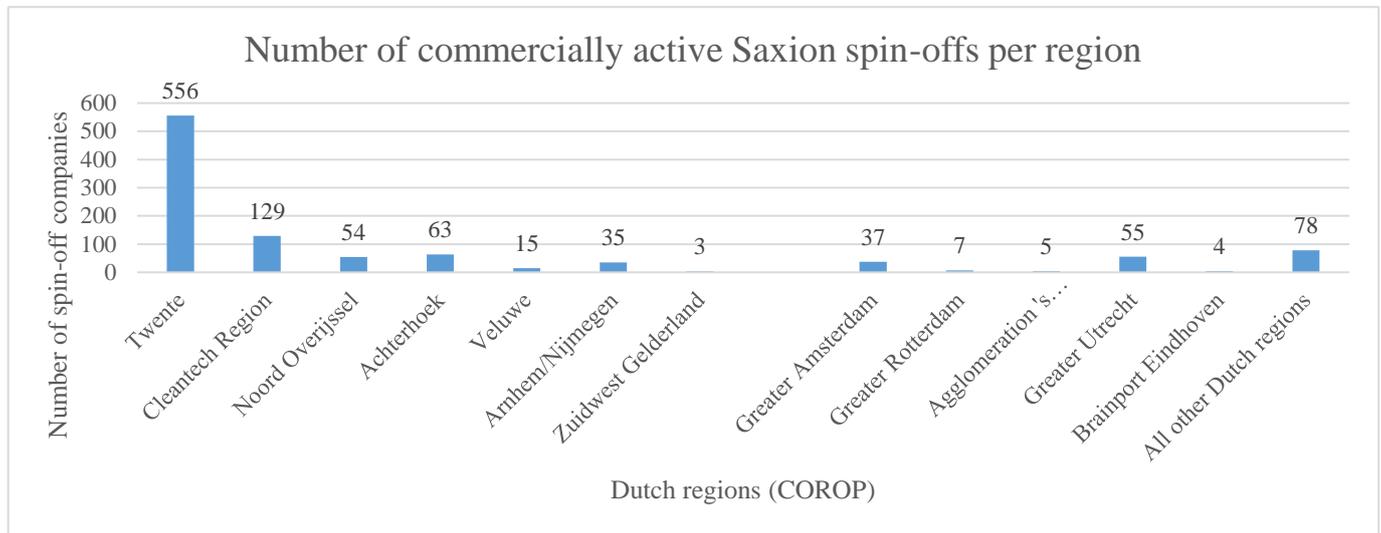


Figure 15: Number of commercially active Saxion spin-offs in 2019 per region

Compared to UT spin-offs, Saxion spin-offs are less attracted to large Dutch agglomerations, although Amsterdam and especially Utrecht are somewhat popular locations. In comparison with the UT spin-offs, Saxion spin-offs are smaller on average. This is caused at least partly by the average age difference of the UT and Saxion spin-offs. Another reason may be that among the Saxion spin-offs there are a lot more business to consumer service based spin-offs than among the UT spin-offs, which are usually more difficult to scale up than product based spin-offs.

3.5. Spin-off migration and development

The last part of the study deals with the migration of spin-offs. Table 6 shows the percentages of all UT spin-offs migrating and not migrating. In total, for all regions of origin, 61% of the UT spin-offs did not move from the location where they were established. On average 88% of the UT spin-offs established in Twente did not move at all (61%) or moved within the region (27%). 12% of all established UT spin-offs in Twente left the region, 6% to one of the large Dutch agglomerations, 2% to the Cleantech Region and 4% to any other region within the Netherlands. The percentage of UT spin-offs staying in the region of the parent university is therefore significantly higher than the percentage reported by Clayman and Holbrook (2003), who found that 79% of the spin-offs from several Canadian universities remained in the region of the parent university. It is also higher than the 83% retention rate reported by Bagchi-Sen, Baines, and Smith (2020) for spin-offs in the UK. They also observed a lower retention rate for university spin-offs in the Greater London area most likely due to a lack of affordable space and/or lack of business incubation. Interestingly, for UT spin-offs started in one of the five largest cities in the Netherlands, the retention rate is also lower than that of Twente, namely 83% (consisting of 59% non-movers, plus 24% movers within the region). In the case of the UT spin-offs this does not lead to a large flow of spin-offs from the large agglomerations towards Twente, but rather towards other Dutch regions. It can be assumed that these companies are “sub-urbanizing” in search for better or cheaper space, but not too far from the market. Examination of the available

individual company data indeed shows that these companies are moving from Amsterdam to Haarlem, Alkmaar or Hilversum for example or from The Hague to Delft and from Greater Utrecht to the Veluwe or Flevoland. Only in a few exceptional cases such companies move to for example Maastricht or the Achterhoek or the Friesland province.

Table 6: Percentages of UT spin-offs migrating and not migrating, including origins and destinations

	Not migrating companies	Migrating companies					
<i>Region of origin</i>		<i>Destination region</i>					
		Twente	5 Largest Dutch agglomerations	Cleantech Region	Other regions	Total	
Twente	61%	27%	6%	2%	4%	100%	
5 largest Dutch agglomerations	59%	3%	24%	2%	12%	100%	
Cleantech Region	69%	5%	3%	13%	10%	100%	
Other regions	59%	5%	7%	1%	28%	100%	
	Average: 61%						

Source: Own compilation

It is often assumed that spin-offs leave economic non-core regions when they have reached a certain size and consider it for example for venture financing or human resource reasons necessary to move to an economic core region (Soetanto & Van Geenhuizen, 2019). Figure 16 shows the percentage of workplaces involved in migration of UT spin-offs, per spin-off type established in Twente. From all the Type I spin-offs, counted for the year of migration, 10.6% of the then existing jobs are moved into another region. This is somewhat smaller than the percentage of type I spin-offs leaving the region, indicating that it are on average the somewhat smaller companies that leave. This pattern of smaller companies leaving the region Twente is clearly visible for the type II and type III spin-offs. For these types, respectively 5.1% and 3.3% of the workplaces have moved out of Twente. For spin-offs of type IV, the situation is slightly different: Here 17.0% of the workplaces have moved out of the region, indicating that the leaving companies are slightly larger than average.

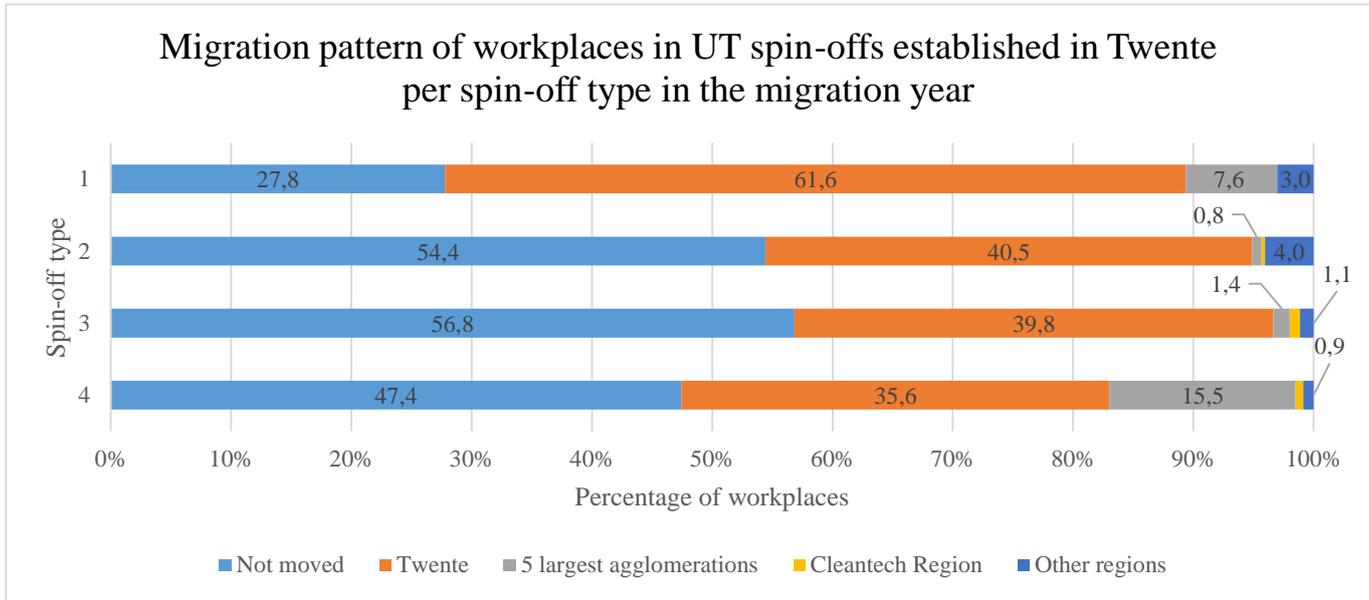


Figure 16: Migration pattern of workplaces in UT spin-offs established in Twente, per spin-off type (counted for the year of migration)

To complete the picture Figure 17 is included, which shows the same information as Figure 16 but then for the last available year of the employment data (the year 2020). This is to compare the division of workplaces in the actual year of moving with the last available data. The resulting picture is striking: Type I spin-offs established in Twente appear to grow faster in the region Twente than in other regions, as the share of the region Twente in the current employment is larger than in the migration year. The employment share of type II spin-offs is roughly equal in the year of the company migration.

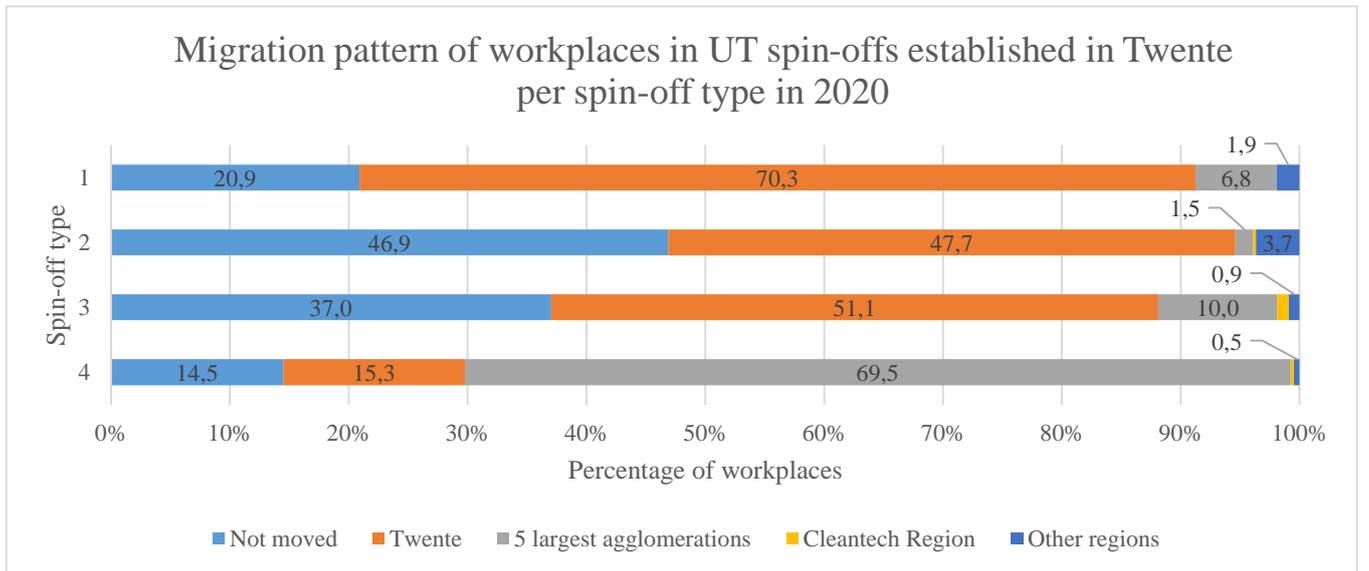


Figure 17: Migration pattern of workplaces in UT spin-offs established in Twente, per spin-off type (in 2020)

Type III spin-offs in the 5 largest Dutch agglomerations grow faster than the ones in Twente. The 4.8% of the companies that moved to one of the large cities offered in the year of migration just 1.4% of the workplaces, but in 2020 no less than 10%. This growth is however dwarfed by the growth of the type IV spin-offs: 8.8% of the type IV spin-offs established in Twente, left the region for a location in one of the 5 largest Dutch agglomerations. In the year of moving, they offered 15.5% of the workplaces. In 2020 however, these spin-offs

offered no less than 69.5% of all workplaces in type IV spin-offs (Note: this large percentage is not because of outlier Booking.com, since this company was not established in the region Twente and therefore does not count in this analysis).

Table 7 Average age of migrating UT spin-offs

Region of origin	Destination region			
	Twente	5 largest Dutch agglomerations	Cleantech Region	Other regions
Twente	8.9	6.7	5.3	5.6
5 largest Dutch agglomerations	6.3	9.5	7.3	4.9
Cleantech Region	12.0	6.5	13.3	3.3
Other regions	6.5	12.3	10.7	7.9

Source: Own compilation

Another aspect of migrating companies is the age of the company when migrating. As described in the literature review, intraregional migration is often caused by lack of space or because of looking for a more representative building. Interregional migration is usually caused by “organizational issues” and/or “business economic reasons”. These differences in age can be observed in Table 7, where the average age of the spin-off while moving is usually higher in the case of an intraregional migration. The average age of spin-offs doing interregional migration is in most cases lower, indicating that spin-offs usually already in earlier stages of their existence discover that the location in their current region does not suit their needs.

To test whether the factors mentioned in the literature review and analysed in this chapter will provide a statistically significant prediction on the question whether a spin-off company has moved or not, a logistic regression analysis has been carried out. The results of this statistical test can be observed in Figure 18. The used regression analysis method was Enter. The predictors entered in the model were: 1. The distance to the parent institution, 2. The age of the spin-off company, 3. The size of the spin-off company. The distance to the parent institution is seen as a predictor because the literature on the subject describes that spin-offs tend to start near to the parent university, because of the organizational similarity and subsequent knowledge relations, while in later stages those knowledge relations tend to wither away. Therefore the chance is bigger that far away located spin-offs have moved (cf. Bathelt & Henn, 2014). For the same reason, the age of the spin-off is also included in the model. The third predictor is the size of the spin-off. Growing spin-off companies will likely have to look for different and larger spaces, so it is logical to assume that larger spin-off companies will have moved (cf. Pellenbarg, 2005; Van Oort et al., 2008a).

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	84.076	3	<.001
	Block	84.076	3	<.001
	Model	84.076	3	<.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	2815.516 ^a	.035	.049

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table^a

Step 1	Observed	HasMoved	Predicted		Percentage Correct
			No	Yes	
Step 1	HasMoved	No	1628	47	97.2
		Yes	678	30	4.2
Overall Percentage					69.6

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	Distancetoparent	.002	.001	18.038	1	<.001	1.002
	Spinoff_age	.044	.006	61.547	1	<.001	1.045
	SpinOffSize	.000	.000	.361	1	.548	1.000
	Constant	-1.490	.086	302.168	1	<.001	.225

a. Variable(s) entered on step 1: Distancetoparent, Spinoff_age, SpinOffSize.

Figure 18: Binary logistic regression model to predict spin-off company migration

The model shows that, keeping all other predictor variables constant, the odds of a migration increased by 0.002 for each extra kilometer that the spin-off is located further from the parent university. The p value for this predictor is less than .001, making this a statistically significant predictor.

The second predictor in the model is the age of the spin-off. Keeping all other predictors constant, the odds of a migration increase by 0.044 for each year of age of the spin-off. The p value for this predictor is less than .001, making this also a statistically significant predictor.

The model also shows that the third predictor, the size of the spin-off does not lead to a noticeable increase or decrease in the odds that a migration has taken place. This indicator is not statistically significant, with a p value of .548.

When looking at the total model, with a X^2 of 84.076, the model is statistically significant with a p value of less than .001. The model predicts the correct outcome in 69.9% of the cases. There are likely other - still unknown - statistically significant predictors, as the amount of false negatives (678 cases) is very high. Nonetheless, these numbers prove that at least two of the three reasons mentioned in the literature on company migration hold for the population of UT and Saxion spin-offs.

4. NEW OR NOVEL RESULTS OF THE THESIS

I propose seven novel theses based on the research results. The theses here reflect the conclusions and recommendations following from the study. The first thesis I propose is about the geographical proximity and goes as follows:

1. *Geographical proximity to the parent university matters for spin-offs, however just for one specific type of spin-offs, namely the most innovative ones with codified intellectual property (Bazen, 2018).*

The research results show that especially the most innovative spin-offs are located close to the university: the statistically significant regression model predicting the distance from the university based on the type of spin-off proves that university spin-offs are a very heterogeneous group of companies. It appears from the data and statistical analysis that the majority of less innovative spin-offs see a location close to the university as not especially necessary or beneficial for their business operations. This shows the importance of knowledge links of innovative spin-offs with their parent university. Apart from a few conceptual papers (See for example Bolzani et al., 2020; Pirnay et al., 2003), there are – to the knowledge of the author – no empirical studies available that focus on the diversity of university spin-offs and the corresponding differences in development and spatial pattern. Therefore, this study is providing a new framework of understanding why certain spin-off companies prefer to be located close to their parent university.

The second thesis is about the difference between research universities and universities of applied sciences:

2. *Spin-offs from research universities and universities of applied sciences spatially behave in a different way, with research university being more concentrated close to the university and university of applied sciences spin-offs more spread out among the region, also in the more rural areas (Bazen, 2020b, 2021).*

The independent t-test showed that the spin-offs of research universities and the spin-offs of universities of applied sciences are two significantly different groups of spin-offs. University spin-offs from research universities are – a bit exaggerated – either located near the parent university or located in the largest population centres within the country (consistent with the expected predictions based on the agglomeration effects). Spin-offs from an applied science university are more spread out through the region of the parent university, but on average don't feel that a location in close geographic proximity to such an institution is beneficial for them.

As third thesis, I would like to draw the attention to the effect of the regional entrepreneurial ecosystem on university spin-offs:

- 3. The entrepreneurial ecosystem is of great importance for the appearance of university spin-offs. Regions with a stronger developed entrepreneurial ecosystem produce substantially more university spin-off companies (Bazen, 2020a; Bazen, 2020b).*

Unlike the university of Twente, Saxion university of applied sciences has campuses in two cities. There are large differences in numbers of spin-offs when comparing the region Twente, with the Enschede campus and the Cleantech region with the Deventer and Apeldoorn campuses. Even though the Deventer and Apeldoorn campuses together are half the size of the Enschede campus, the number of Saxion spin-offs in Twente is no less than four times higher than in the Cleantech Region. Since the university has a similar entrepreneurship support strategy in both campuses, the large difference must be caused by external factors, the regional entrepreneurial ecosystem. In Twente the regional entrepreneurial ecosystem is more developed, especially also because of the Novel-T support organization.

The fourth thesis I would like to propose is about the effect of support institutions on the development of spin-offs:

- 4. Support organizations can significantly improve the regional entrepreneurial ecosystem and are therefore invaluable organizations in terms of innovative entrepreneurship support (Bazen, 2017; Petkovski, Fedajev, & Bazen, 2022).*

From the research results it becomes clear that entrepreneurship support organizations, in case of university spin-offs in the eastern Netherlands, mostly the Novel-T organization, play an important role in providing support with the start of new businesses and the translation of university knowledge to commercial products/services. As is seen in the previous thesis as well as the general research results of the second campus area of Saxion (in Deventer), missing such support organizations significantly decreases the birth and survival rates of spin-offs.

As fifth thesis I would like to formulate:

- 5. In terms of regional development of semi-peripheral regions, it is more useful to focus entrepreneurship support on product-based spin-offs than on service-based spin-offs (Bazen, 2021).*

For spin-offs of both the UT and Saxion the research results show a clear tendency that product-based spin-offs (for example in the sector industry) have a larger chance to stay in the region of origin than service-based spin-offs (for example in ICT, health care or personal services). This can be explained by the stronger dependency on knowledge from the university at such spin-offs. For service-based spin-offs it is in most cases more profitable to be in places where large groups customers and potential workers are, than to be specifically at places where knowledge is generated.

The sixth thesis is about the general consequences for the economic safety and security of the region

6. *Supporting spin-off companies is useful for the economic development of regions, as it increases the absorptive capacity of the region for new innovative technologies (Bazen & Flooren, 2020).*

A strong focus on the research university spin-offs would lead to a strengthening of the regional innovation network, however, most of the economic and employment effects would be just felt in or around the city with the research university. For universities of applied sciences spin-offs, it can be assumed that their contribution to the regional innovation system would be on average lower (the independent sample t-test shows significant differences in development and economic impact between spin-offs from research universities and universities of applied sciences). These spin-offs however on the other hand are much more spread out through the region, providing also economic impact in more rural communities. In terms of policy support, both types of spin-offs therefore have their own strong points: Research university spin-offs in fostering innovation in the region and university of applied science spin-offs by spreading university knowledge over larger regions. All in all this means that spin-offs both in rural as well as in urban parts of the region actively support the further development of the absorptive capacity of the regional businesses for new innovative technologies and/or services.

7. *University spin-offs are game changers in terms of improving the regional economic structure, however the direct effect is only significant in the largest cities with the highest knowledge & resource links available (Bazen, 2018; Bazen, 2020b, 2021).*

The evidence from this study shows that university spin-off companies are indeed game changers in regional economic development, although their direct economic effect in terms of number of workplaces is quite limited. Only in the city of Enschede, where both universities of this study are located, there is a significant direct economic influence of the spin-offs on the economy, around 5% of all jobs in the city are within university spin-offs, making these types of businesses a factor of major local importance. It can be assumed that the location of these spin-off businesses close to the parent university is an important location factor for them: it helps to provide human capital (young graduates) as well as relatively easy access to university knowledge and (if relevant) common research projects. In more rural parts of the region, the direct employment effects are much lower. What has not been measured and therefore one of the limitations of this study, are the indirect effects of the spin-off companies, in the sense of how those companies help to improve the production, logistic and/or sales technology for regional customers (usually SMEs). Measuring these indirect effects of spin-offs on the regional innovation system is subject for further study. But even without the indirect effects, based on just the direct effects, it can already be concluded that university spin-offs are indeed a potential game changer for peripheral regions.

5. PRACTICAL RELEVANCE OF THE RESULTS

This final chapter provides some recommendations for policy makers. Since the goal of this study is to contribute to the understanding of the economic development of semi-peripheral regions, it is very important to apply the results of this study for policy makers in regional economic development.

First and foremost, it becomes clear from all available sources that changing the economic structure of a (border) region which has been peripheralized due to economic changes (in the case of the region Twente, because of the collapse of the textile industry), is a long-term process, which takes decades of conscientious investment and building. The literature on the subject clearly shows there is no “wonder pill”, which can be applied to get quick results. Instead, it is necessary to have long term commitment to a chosen path. The economic development of the region Twente can be for a large part explained by the policy of developing academic entrepreneurship, initiated by the University Twente, but strongly supported by the municipal government of Enschede, the regional government of Twente and the province of Overijssel as well as Saxion university of applied sciences, in supporting the development of the NovelT entrepreneurial ecosystem. The result is a schoolbook example of triple helix cooperation (Etzkowitz & Leydesdorff, 1995) between government, university and business. The support measures of the UT have had a largely “low selective” character (Benneworth & Charles, 2004), which means that companies from many different economic sectors have been supported throughout the last couple of decades. There was barely any selection of specific economic sectors fitting within one or a few top-down selected business clusters. Instead, entrepreneurship support measures were given to any student/graduate/staff member with a reasonable business idea to commercialize university knowledge. When looking at the pool of university spin-offs in this study, it shows that even with such a low selective policy model of supporting entrepreneurship, only a few economic sectors stand out as areas in which university spin-offs are most successful. For the most innovative high tech spin-offs, these are the economic sectors industry (more in particular in high tech systems and materials as well as life sciences and health), rather closely following the specializations of the UT. The same applies for the ICT sector, which also yields a lot of spin-off companies, just as predicted by the literature on the subject (Bagchi-Sen, Baines, & Smith, 2022; Zhang, 2009). In other words: the specialization of the university provides by itself the business opportunities for entrepreneurial students/staff members (Messeni Petruzzelli & Murgia, 2022). Agreeing with Shapero (1975) that entrepreneurship is coinciding with “moments of life displacement”, such as leaving the university as a student/graduate or the end of a temporal employment contract at the end of a research project, it is important to show at exactly such moments the options of getting support for building a new venture, preferably based on newly developed knowledge.

It can be seen in the results of this study that the regional spin-off retention rate of spin-offs established in a semi-peripheral region such as Twente is high. This means that it is

important to stimulate the establishment of companies in the region of the parent university in the first place. This is especially relevant for more innovative spin-offs which have a need for intensive knowledge relations with the parent university, in order to further develop their product (or service). Product based spin-offs appear to have a stronger need for such knowledge relations than service based spin-offs, therefore requiring most likely more support. There is of course no guarantee that spin-offs stay in the region: The results of this study show that especially fast growing and therefore iconic spin-off companies are likely to leave the region of origin, in search for a location in the large Dutch agglomerations. In the literature on this subject it is concluded that those companies search for a site close to major markets and/or where human capital and venture capital can more easily be found. This should however not discourage policy makers from continuing to support the development of new businesses in such regions: evidence from the region Twente shows that on the longer term these policies have indeed helped to improve the regional economic situation. This is caused by the impact of the spin-off companies on the regional innovation system, which goes further than the direct economic impact of the number of workplaces within these spin-offs (Bercovitz & Feldman, 2006; Clayman & Holbrook, 2003; Hayter, 2013). Even when semi-peripheral regions like Twente are sometimes classified as “incubator regions”, where entrepreneurs have good opportunities and support for starting a business and then, when the business develops, are moving out to economic core regions, where the business could really grow further. The results of this study show that for both the UT and Saxion, this is only a limited phenomenon. Spin-offs of both universities are quite likely to stay in the region of origin. Data on migration shows that on average spin-offs move between regions in earlier years of their existence than that they move within regions. This is strong evidence to support the conclusions of Pellenburg et al. (2005) that companies have different motives to move between regions (mainly business economic reasons) and within regions (mainly space and place related issues). In later stages of their existence, when growing to more mature stages, many spin-offs move to a different location within the same region, for example to a location with more space for expansion or to a better accessible location. For policy makers working on regional development strategies, this is also an important moment. If such companies cannot find suitable locations within their region of origin, they may also decide to leave the region altogether. And given the multiplier effect that these spin-off companies have on the regional innovation system, the out-migration of such companies has much more consequences for the innovation potential of the region than the loss of just 25-50 jobs in a single spin-off company. When looking at the differences between research university spin-offs and university of applied sciences spin-offs, for the former the geographical proximity to the parent university (knowledge spillovers) seems to be much more important than for the – usually – lower tech spin-offs of universities of applied sciences. In terms of supporting the development of university spin-offs, a strong focus on the research university spin-offs would lead to a strengthening of the regional innovation network, however, most of the economic and employment effects would be just felt in or around the city with the research university. For universities of

applied sciences spin-offs, it can be assumed that their contribution to the regional innovation system would be on average lower, however, these spin-offs are much more spread out through the region, providing also economic impact in more rural communities. In terms of policy support, both type of spin-offs therefore have their own strong points.

6. PUBLICATIONS ON THE TOPIC OF THE THESIS



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Subject: PhD Publication List

Candidate: Jacob Cornelis Bazen

Doctoral School: Károly Ihrig Doctoral School of Management and Business

MTMT ID: 10052522

List of publications related to the dissertation

Books (5)

1. **Bazen, J. C.:** Measuring the effects of the Novel-T supported entrepreneurial ecosystem: University of Twente Spin-off monitor 2021. Saxion University of Applied Sciences, Enschede, 71 p., 2021.
2. **Bazen, J. C., Flooren, M.:** Ondernemerschap bij Saxion studenten, alumni en medewerkers: Een onderzoek naar de economische impact van Saxion spin-offs op de regio. Hogeschool Saxion, lectoraat Regio Ontwikkeling, Uitgever, 33 p., 2020. ISBN: 9789462130302
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4. Szerk. **Bazen, J. C., Van Klink, H.:** Trends and developments in the renewable energy sector in Ukraine: with a special focus on opportunities and threats for using biomass in the energy transition. Saxion University of Applied Sciences, Enschede, 83 p., 2018. ISBN: 9789462130289
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8. **Bazen, J. C.:** Migration Patterns of University Spin-offs: Case Study of Region Twente, a Non-Core Region in the Netherlands.
On-line Journal Modelling the New Europe. 27, 4-33, 2018. EISSN: 2247-0514.
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Journal of Tourism and Services. 5, 77-94, 2014. ISSN: 1804-5650.

Total IF of journals (all publications): 3,85

Total IF of journals (publications related to the dissertation): 3,85

The Candidate's publication data submitted to the iDEa Tudóstér have been validated by DEENK on the basis of Web of Science, Scopus and Journal Citation Report (Impact Factor) databases.

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