Hesse, Nora

Conference Paper

Longer is not necessarily better: Career paths of academic entrepreneurs and university spin-off growth in Germany

53rd Congress of the European Regional Science Association: "Regional Integration: Europe, the Mediterranean and the World Economy", 27-31 August 2013, Palermo, Italy

Provided in Cooperation with:
European Regional Science Association (ERSA)

Suggested Citation: Hesse, Nora (2013) : Longer is not necessarily better: Career paths of academic entrepreneurs and university spin-off growth in Germany, 53rd Congress of the European Regional Science Association: "Regional Integration: Europe, the Mediterranean and the World Economy", 27-31 August 2013, Palermo, Italy, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:
https://hdl.handle.net/10419/124064

Longer is not necessarily better – Career paths of academic entrepreneurs and university spin-off growth in Germany

Nora Hesse, Institute of Economic and Cultural Geography, Leibniz Universität Hannover

Abstract

Based on three theoretical perspectives I investigate how academic entrepreneurs' career paths can influence university spin-off growth in terms of number of employees. The results from the qualitative content analysis and extreme case analysis show that each university status comprises certain advantages and disadvantages. Academic entrepreneurs are located in a trade-off. More human capital and a higher university status are not necessarily advantageous for long-term university spin-off growth. The willingness and ability for role identity change in terms of the degree of commitment to the entrepreneurial role is very important.

1 Introduction

Universities are increasingly seen as engines for regional innovation and economic growth (see LAWTON SMITH 2007; ETZKOWITZ 2008; MUSTAR/WRIGHT/CLARYSSE 2008). Some famous high-tech regions have developed on the basis of universities, for example Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (see SAXENIAN 1983; STERNBERG 1995). In these regions, university spin-offs are regarded as one important vehicle of knowledge transfer and commercialization from university to industry. Furthermore, empirical studies confirm that university spin-offs have a higher employment growth (see EGELN et al. 2002; CZARNITZKI/RAMMER/TOOLE 2013) and a higher survival rate (see LAWTON SMITH/HO 2006; ZHANG 2009) compared to average firms. This of course benefits regional development and is therefore a key interest among policy makers.

The focus of this paper is on the individuals who stand behind these processes, academic entrepreneurs, who develop great ideas at university and decide to put them into practice. One famous example is the Stanford University PhD Student Larry Page, who founded the internet search engine Google (see SHANE 2004). Academic entrepreneurs do not comprise a homogeneous group. According to the time they have spent in university before founding a university spin-off, they have been through different university career paths and so, they can

be students, research staff or professors. Hence, the aim of this paper is to investigate how academic entrepreneurs' university career can affect university spin-off growth. For this purpose, research questions are derived from three theoretical perspectives: university status, human capital and role identity.

The relationship between entrepreneurs' career paths and growth intentions is still inconclusive. While some quantitative studies deny an influence (KOLVEREID 1992; BIRLEY/WESTHEAD 1994) others empirically prove it (see CASSAR 2007). Obviously, this relationship can hardly be investigated by quantitative analysis, which makes it necessary to define rigid independent variables (see KODITHUWAKKU/ROSA 2002; DRUILHE/GARNSEY 2004). In order to investigate this complex relationship more in-depth, my empirical analysis is based on qualitative survey data from 85 academic entrepreneurs of two German universities. The analytical process relied on a qualitative content analysis and extreme case analysis.

This paper is structured as followed: First the three theoretical perspectives are discussed and three research questions are derived (section 2). After introducing the data and methods used in this paper and pointing out limitations (section 3), empirical results of the qualitative content analysis (section 4) and extreme case analysis (section 5) are discussed. Finally, a conclusion is drawn (section 6).

2 Theoretical Considerations

In order to explain the relationship between academic entrepreneurs' career paths and subsequent university spin-off growth in depth three streams of literature are relevant for this discussion: the university status perspective, the human capital perspective and the role identity perspective. The first and last perspective were also selected by DING and CHOI (2011), who investigated the influence of scientists' career paths on their decision to create a venture or join a scientific board. The human capital perspective is for example also used by MÜLLER (2006) for explaining university spin-offs' success.

2.1 University Status Perspective

With advancing time in university, scientists are likely to climb in the university hierarchy. With increasing university status, reputation and access to resource through the social network usually rise (see DING/CHOI 2011), which can be advantageous for university spin-off growth. Founding a university spin-off is an outstanding event in the life of a scientist. Normally

scientists think very well before taking this step: if they want to take the risk, what they might have to loose, and what their social network would think about the decision. It is important to keep in mind that university spin-off creation is still a controversial behavior in certain universities and areas of studies in Germany (see DÖRRE/NEIS 2010:144). In contrast to the US, the prospects of a return to academia after leaving university for starting up a university spin-off are quite low in Germany (see WENTLAND/KNIE/SIMON 2011:4).

At the beginning of the university career individuals have usually little to lose. They are open for new adventures and willing to take risks because they still do not belong to a specific social group where they want to meet the norms. This freedom enables them to generate extraordinary innovations apart from social group norms (see PHILLIPS/ZUCKERMAN 2001:380), which can be advantageous for university spin-off growth. However, this leads also to the disadvantage at the same time. Low university status entrepreneurs do not possess a social network, which enables them to access resources and information easily. This might hinder university spin-off growth.

At the middle level of the university career academics want to belong to a certain social group which makes them quite dependent on external expectations. The fear of disenfranchisement makes them act quite conservative. On the one hand they have already reached a certain status that they put on risk. On the other hand they have not gained reputation and resources in an extent that gives them the security and freedom as is the case for high status entrepreneurs (see PHILLIPS/ZUCKERMAN 2001:380). Nevertheless, it can be assumed that middle university status entrepreneurs possess more reputation than low university status entrepreneurs. This makes it easier for them to overcome the liability of newness (see GARNSEY 1998:534) and foster university spin-off growth. Also, they have a wider social network than low university status entrepreneurs, which also facilitates the access to relevant resources in case the university spin-off matches existing social group norms (see PHILLIPS/ZUCKERMAN 2001:380).

Individuals with a high university status, especially star scientists, usually posses good access to resources and information to stand and evaluate the risks connected with founding a university spin-off (see PHILLIPS/ZUCKERMAN 2001:380). They enjoy a high level of reputation within their subject and social network. This makes it easier for them to gain credibility early, acquire funding and attract customers (see SHANE 2004:160 f.), which is advantageous for university spin-off growth. Following PHILLIPS and ZUCKERMAN (2001:380) it can be assumed that high university status entrepreneurs tend to exploit opportunities,

which are in line with the norms of their social network. Accordingly, individuals in high status positions are oftentimes asked by industry partners to build up a company. Many of them will found the university spin-off on demand, which makes it easier to enter and survive on the market at least in the first years.

2.2 Human Capital Perspective

Following the human capital theory individuals are endowed with skills and knowledge and they can increase their overall knowledge through investments in their human capital like schooling, on-the-job-training, searching for information, etc. (see BECKER 1975). Early in the academic life cycle scientists invest in their human capital in order to gain scientific expertise in a specific subject. This usually happens through basic science research. After achieving important milestones scientists create a university spin-off to exploit their research results or specific competencies they have acquired in order to get financial returns on their human capital (see SHANE 2004:159; DING/CHOI 2011). This argument also received empirical support (see KLOFSTEN/JONES-EVANS 2000).

In the field of entrepreneurship, investments in human capital are usually seen as an advantage in terms of company's survival, growth and profitability (see SHANE 2004:240; STÜTZER 2010:25; PARKER 2005:320; COLOMBO/GRILLI 2005) but LAZEAR (2005) differentiates between employees and entrepreneurs. While employees tend to be specialists in their field, entrepreneurs should rather be Jack-of-all-Trades. This means entrepreneurs have to combine different skills. Large investments in one special subject are an obstacle for being an entrepreneur. Following LAZEAR (2005), it is quite obvious that scientists obtained expertise in their field, but this kind of knowledge alone is not sufficient. Furthermore, large investments in human capital for example lead to a higher risk aversion and higher opportunity costs (see DAVIDSSON/HONIG 2003). Especially in the context of university spin-offs a positive relationship between human capital acquisition in university and company's success cannot be considered automatically (see COLIN MASON 2011; HELM/MAURONER 2007; WENNBERG/WIKLUND/WRIGHT 2011), because at a certain point in time the danger of a cognitive lock-in might develop (see MURRAY/HÄUBL 2007).

The acquisition of scientific expertise in university is strongly related to the specificity of the university knowledge applied in the university spin-off. Regarding the degree of knowledge transferred literature distinguishes exploitation spin-offs, competence spin-offs and academic start-ups (see BATHELT/KOGLER/MUNRO 2010; EGELN et al. 2002). Exploitation spin-offs are based on concrete research results or novel methods, which at least one academic

entrepreneur has developed at university. Competence spin-offs emerged from specific knowledge or skills, which at least one academic entrepreneur has acquired in university. The academic entrepreneur's specific competence enables him or her to develop the original idea further, oftentimes even independently from university. By contrast, academic start-ups comprise only generic knowledge or skills, which at least one Academic entrepreneur has acquired in university (see EGELN et al. 2002). An empirical study for Germany discovered that external stakeholders react more constrained to university spin-offs of high status inventors, who want to exploit research results. This is because firstly, exploitation spin-offs need a large team which contributes various competencies. Therefore, the sales productivity is quite low in the first years. Secondly, standardization and economies of scale for exploitation spin-offs are difficult to achieve (see EGELN et al. 2002:57).

2.3 Role Identity Perspective

Scientists and entrepreneurs have in principle two quite opposite value systems and academic entrepreneurs obviously operate in an area of tension (see NORBERT SZYPERSKI/KLANDT 1981). These opposite value systems are reflected in the scientists' and entrepreneurs' attitudes and behaviors. The respective mentality is firmly anchored in their minds and cannot be changed easily. This means that scientists have to shift in roles to become successful academic entrepreneurs (see JAIN/GEORGE/MALTARICH 2009). CHANDLER and JANSEN (1992) for example identified three different roles a founder has to adopt: an entrepreneurial, a managerial and a technical-functional role. Entrepreneurs act in a highly competitive market environment. They seek for market success through profit-orientation and market acceptance. In utmost contrast, scientists act in an environment far apart from economic constraints which gives them the opportunity to pursue independent research. They are used to write applications for research projects to acquire funding and they are mainly interested in the technological success (see STEPHAN/LEVIN 1996). German scientists are seeking reputation mainly through own publications in highly specialized journals and secondly through teaching, whereas patenting, technology transfer and entrepreneurial activity are less important (see WENTLAND/KNIE/SIMON 2011). So if scientists transfer their academic habits to their new roles as entrepreneurs, they might miss to orientate to the market and to force economic success through identifying buyers and making marketing (see NÖRR 2010:55).

ERDÖS and VARGA (2012) rightly state that empirical studies hardly consider the role of scientists as entrepreneurs. Adopting new roles is a difficult task especially for scientists, who passed a long-term university career before founding a university spin-off. Due to the long

and intense socialization process in university (see DING/CHOI 2011:72), they have another entrepreneurial attitude than students or doctoral students, who might have never planned to work for the university for a longer time and who did not internalize the university value system in such intensity (see MANGEMATIN 2000:754). Therefore, it can be generally expected, that doctors and professors have both a lower entrepreneurial and profit orientation. Therefore, they might create university spin-offs with less growth potential.

Scientists, who stayed in university for a long time, identify themselves in such an extent with their academic role that they are able or not willing to change it even after founding a university spin-off. This persistence of identity can lead to the situation that the academic entrepreneur wants to stay in university and run the university spin-off only part-time (see BRAUN-THÜRMANN/KNIE/SIMON 2010:100). Empirical evidence exists that it is important whether the academic entrepreneur has left university for setting up a company or not (see PIRNAY/SURLEMONT/NLEMVO 2003; SHANE 2004:249). Heading the university spin-off only on part-time base bears the risk of reducing personal commitment and thereby growth expectations (see EGELN et al. 2002:37, 55 f.).

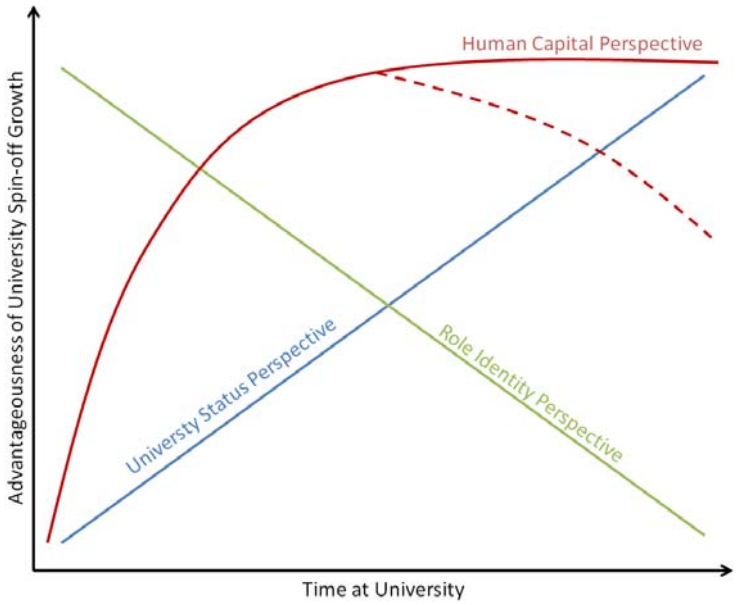
2.4 Developing Research Questions

In the theoretical discussion the importance of academic entrepreneurs' career paths for university spin-off growth were explained through three different perspectives, of which the following research questions can be derived:

1. Are academic entrepreneurs more likely to found a high growth university spin-off with rising university status?
2. Do rising human capital and resulting knowledge transfer have a diminishing marginal utility for university spin-off growth and may even develop to a disadvantage?
3. Do difficulties with role identity change increase with advancing time in university and hinder university spin-off growth?

The research questions lead to competing expectations for university spin-off growth as summarized in **Figure 1**.

In the following qualitative analysis of the academic entrepreneurs' career paths I investigate how the university status, human capital and role identity influence university spin-off growth in terms of number of employees. Furthermore, I show the importance and interaction of the three perspectives for selected cases. Therefore, I identify academic entrepreneurs of high growth and low growth university spin-offs and analyze their career paths in depth.



Source: Own illustration.

Figure 1: Conceptual Framework.

3 Data and methods

The data used in this paper was collected in the context of a research project funded by Pro*Niedersachsen, a funding program of the Ministry of Science and Culture in Lower Saxony. The project named "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen" receives funding from 2010 to 2013 and consists of a three-person team.

3.1 Defining Academic Entrepreneurs

Following PIRNAY et al. (2003) and SMILOR et al. (1990) we define academic entrepreneurs as scientists or students who left university to start a company or who founded (or co-founded with others) the company while still affiliated with university to exploit their knowledge and /or skills acquired at university in a profit-making perspective. Accordingly, the companies created are called university spin-offs. In contrast to some other authors, who only consider technology-oriented university spin-offs in their studies (see for example SMILOR/GIBSON/DIETRICH 1990), we take a broader view of knowledge transfer by taking into account also academic entrepreneurs of knowledge intensive service companies (see for example also RAPPERT/WEBSTER/CHARLES 1999).

I consider university spin-offs, which were founded from 1980 until 2011. The time between leaving university and official business formation should not exceed a maximum of three

years because the academic entrepreneur should not have worked too many years in industry before founding a spin-off based on university knowledge (see PIRNAY/SURLEMONT/NLEMVO 2003; WENNBERG/WIKLUND/WRIGHT 2011). The temporal boundary of a maximum of three years between leaving university and setting up a spin-off has shown to be a reasonable solution. The academic entrepreneur may have gained significant knowledge in the time of employment beyond the university. However, we consider that a sufficient time period is necessary for setting up a company, especially in high-tech sectors.

3.2 Data Sources and Sampling Approach

The cases were drawn from the two biggest universities in Lower Saxony, Germany as measured by number of graduates in subjects which are more common for university spin-offs, number of scientific staff, and research expenditures. Despite these common characteristics, they show significant differences in spin-off activity and entrepreneurial conditions (see SCHMUDE/AEVERMANN/HEUMANN 2011). The two mid-range universities Hannover and Göttingen are located in regions outside high-tech clusters with a rather weak entrepreneurial culture. They are hence a particularly suitable example for displaying the German reality.

The data on university spin-offs in Germany is far from being accurate. The total sample of university spin-offs for the two universities was therefore composed as follows in order to identify as many academic entrepreneurs as possible. In the first step of data collection we had informal discussions with leaders of the technology transfer offices (TTO's) and employees of different economic development agencies in the two survey regions Hannover and Göttingen. In contrast to other studies (see for example ???), we also asked the heads of all institutes of the two universities for information about university spin-offs by mail in order to avoid a bias for the benefit of university spin-offs which used advice on funding and financing matters. Furthermore, we initiated a search operation through the business network XING in order to capture also university spin-offs, which neither had contact with the current faculty staff nor with the technology transfer offices (TTO's) and employees of different economic development agencies.

The second step of data collection was a validation of all contacts we collected by e-mail and further internet search. In many cases we still did not know if they are academic entrepreneurs according to our definition. In total, we obtained a list of 328 academic entrepreneurs of both universities. From this population a sample of 201 academic entrepreneurs was contacted via e-mail, telephone and XING, of which 116 were unresponsive or did not agree to an

interview. A sampling grid was used to ensure a heterogenic sample structure (see SCHREIER/NADERER/BALZER 2007; BERNARD/RYAN 2009). Two independent variables were considered: university and academic entrepreneurs' university status divided into two basic categories: students or scientists. The cases were equally distributed throughout each possible combination of the expressions of those characteristics.

In the third step of data collection, we carried out a total of 85 semi structured face-to-face and telephone interviews [1] (see BERNARD/RYAN 2009:29 ff.) with at least one founding member of the university spin-off during the period September 2011 to January 2012. The face-to-face interviews mostly took place in the respective company[2] and ranged from 45 minutes to two and a half hours in length. The vast majority of interviews was openly recorded and directly transcribed[3]. Throughout the interviews, we asked open-ended questions chronologically oriented to the phases of preparing, establishing, and developing a university spin-off (see VOHORA/WRIGHT/LOCKETT 2004; ROBERTS/MALONE 1996; RASMUSSEN 2011). During and after the interviews the interviewer took field notes. Furthermore, information collected from university spin-offs' websites and press articles augmented the data.

3.3 Data Coding and Analysis

In the first step, I conducted a qualitative content analysis with all 85 transcribed interviews (see MAYRING 2008b, 2008a; GLÄSER/LAUDEL 2009) which was supported by the qualitative data analysis software NVivo. **Table 1** shows important factors deriving from the three theoretical perspectives. In the qualitative content analysis these factors were considered.

In order to differentiate different university statuses I developed six categorizations, which show the university status of every academic entrepreneur at the time of the university spin-off creation. The different university statuses are categorized as follows: (1) "Students" who were still studying at university. (2) "Graduates" who founded the university spin-off after graduating from university. (3) "Doctoral students" or research associates without doctor's degree (4) "Doctors" who have already achieved the doctoral degree and left the university. (5) "Postdoctoral fellows" who worked at university after achieving the doctoral degree. In

[1] Only for a minority of cases due to distance or scheduling problems we conducted a telephone interview.

[2] Only a few spin-off founders were interviewed in neutral places because of shortage of space or long distances to the respective companies.

[3] In a few cases a content protocol was written during the interview if the interviewee rejected a record.

most cases the individuals are working on their habilitation[4]. (6) "Professors" including private lecturer, adjunct professors and emeriti. In this category the individuals have finished their habilitation.

Table 1: Summary of Theoretical Perspectives and Important Factors.

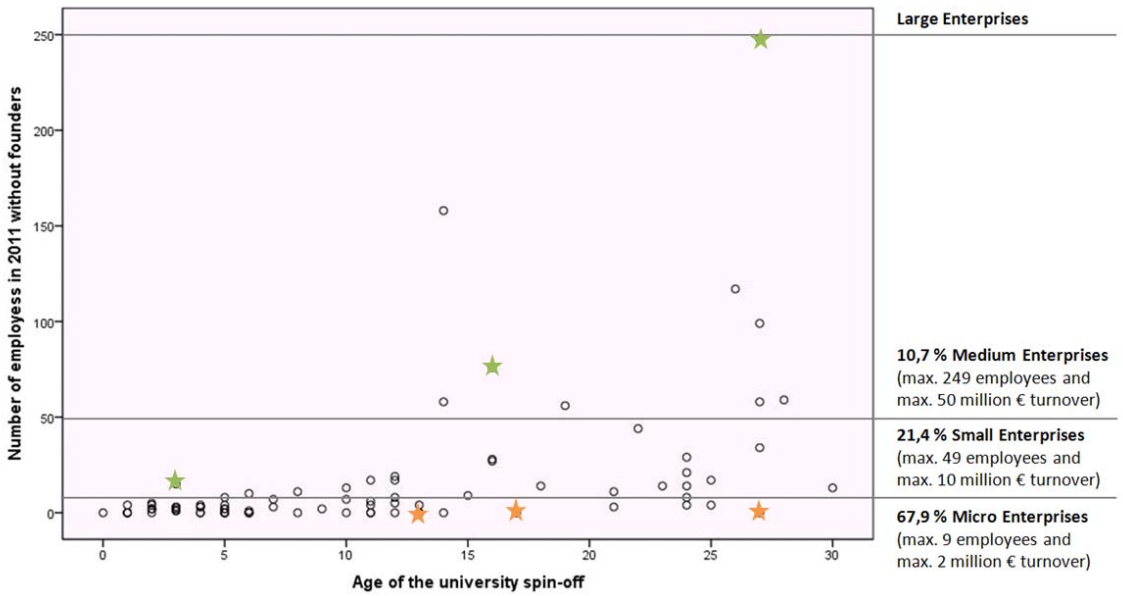
Theoretical perspectives	Important factors	Description
University status perspective	Reputation and access to resources through social network	Contacts to and recognition in scientific community and private economy
	Independence	Relationship between university spin-off and university
Human capital perspective	Scientific expertise and resulting knowledge transfer	Degree of specificity of the university knowledge applied differentiating exploitation spin-offs, competence spin-offs and academic start-ups
	Management skills	Mention of management skills acquired at university on-the-job, which were helpful for university spin-off
Role identity perspective	Identification with Entrepreneurial Role	Occurrence of the desire to be self-employed differentiating before studies, during studies, during doctoral studies, after doctorate and later, directly with the idea Mention of difficulties concerning role identity change in terms of profit orientation, workload, etc.
	Commitment to University Spin-off	Differentiation between left university and still works at university

In the second step, I identified six comparable academic entrepreneurs of high growth and low growth university spin-offs measured as the increase in employees[5] (see **Figure 2**). This approach is especially useful for a contrasting comparison and an identification of best practices. Although high growth university spin-offs are rather rare cases in our sample, they are of course the most favored on the part of policy and most eligible for support because they have a high influence on regional economic growth. In contrast, low growth university spin-offs have a low influence on regional economic growth but they occur more frequently and

[4] Qualification phase after the doctorate for a teaching career in higher education.

[5] This paper focuses on employment as a measure of growth because it has the most consistent positive correlation with other growth measures and is a key interest among policy makers (see WIKLUND 1998; DAVIDSSON/ACHTENHAGEN/NALDI 2007). Furthermore, it is less susceptible to fluctuations and a good indicator for the university spin-offs' overall assets (see GIBCUS/STAM 2012).

thus contribute to regional economic diversity and innovation. The selection of extreme cases allows investigating in-depth how academic entrepreneurs' career paths contribute to university spin-off growth.



Source: Own survey 2011.
Note: N = 85. One case corresponds to one university spin-off. Number of employees is based on full-time equivalents. R^2=0,22. Categorization of enterprises in accordance with the Federal Bureau of Statistics (2013). Selected cases for extreme case study highlighted in yellow and green.

Figure 2: Identification of Extreme Cases

3.4 Limitations

Firstly, following limitations regarding the transferability of the results should be considered. Qualitative research generally focuses on analytical generalization. Statistical generalization is only limited (see MILES/HUBERMAN 1994), although this study involves a relatively large sample. The results are solely based on a sample within the German context, whereas both universities are located in the same federal state with comparable locational environments. The results are therefore only to a limited extent transferable to other regions or countries. Moreover, the results of this study are only valid for university spin-off growth in terms of number of employees. Other definitions of university spin-off growth may lead to different results. Furthermore, university spin-off growth should not be equated with success, because success always depends on the respective business goals (see HAYTER 2010).

Secondly, following data-related biases should be considered. Our study is largely based on established university spin-offs. We only contacted academic entrepreneurs, who were still on the market at the time of the survey, although a large part of the academic entrepreneurs does not succeed in establishing and running a university spin-off. Furthermore, we only took

private limited companies and corporations into account. Thus, a general success bias might exist. One could also assume bias results due to non-response. However, academic entrepreneurs, who did not respond to our contact request, could be both, less successful or more successful. Some may be embarrassed, others were too busy. We interviewed academic entrepreneurs ex-post. A retrospective study always tends to memory decay. There is a risk that outcomes are assigned to circumstances that did not in fact exist at that time.

Finally, the focus in the qualitative content analysis is only on the differences of university statuses which might influence university spin-off growth. Therefore I do not go into detail regarding advantages and disadvantages which all our interviewees have in common. Generally all the university spin-offs in our sample are knowledge intensive. A relatively high amount of human capital can be assumed for all academic entrepreneurs in the sample. Independently from the university status, there are academic entrepreneurs in the sample who have prior entrepreneurial experiences and therefore huge advantages. However, the vast majority of the interviewees had to cope with a lack of business knowledge. Because of the new products and services invented it is difficult to estimate the market potential and costumer demand. Many academic entrepreneurs of all university statuses had to cope with problems in entering the market.

4 Results of Qualitative Content Analysis

Based on the theoretical perspectives discussed above and by use of a qualitative content analysis, I show how different aspects in the university career path can affect university spin-off growth. The results for each theoretical perspective are explained in individual chapters. Within the chapters different university statuses are addressed.

4.1 Results from University Status Perspective

In the following, I present the results concerning the first research question "Are academic entrepreneurs more likely to found a high growth university spin-off with rising university status?" Therefore I discuss the advantages and disadvantages of low, middle and high university status entrepreneurs successively.

Low status university entrepreneurs like students and graduates starting a university spin-off have low entry barriers. In line with the theoretical assumption several of them report that they are used to cope with little income anyway and are willing to take risks at the same time, as the following quotation of a graduate indicates: *"Now we are studying. Now we get along*

with little money. Now we can try what happens if we start a company with things which are brought to the university's attention but what the university cannot carry out." (USO08). This quotation also indicates that students are still quite flexible, which is also in line with the theoretical assumption. At the beginning of the university career, individuals are also more willing to learn something new and to adapt to new situations quickly. Low status academic entrepreneurs have to take only little responsibility in their private and professional lives. Therefore they are able to realize their freedom. On the other hand, some students and even graduates had to cope with legitimacy problems in the first years, as a student reports: *"We had the image of a students' firm for many years. We had to fight for a long time. Especially the competent authorities partly have not taken us seriously, although this was actually ungrounded after a certain initial phase." (USO04).* In some sectors, like information technology, a young, dynamic firm's image might not be an obstacle, but in other sectors, like scientific and technical services, it is. Established scientists normally do not have to cope with such prejudices.

Middle university status entrepreneurs like doctoral students also enjoy a high degree of freedom because in Germany doctoral students usually only have part-time contracts. They can plan the rest of their time relatively freely, as this doctoral student refers: *"With a professor, who would have said: 'If you do not work on your thesis for 100 % I will dismiss you!', we would have had a problem." (USO74).* Nevertheless, the triple burden of working in university, writing a doctoral thesis and establishing a university spin-off give doctoral students oftentimes a hard struggle. This struggle becomes even harder the better the university spin-off performs. As a result, in most cases it takes them at least longer to finish their doctorate if they do not even break up their theses, as one third of the doctoral students in the sample did. Nevertheless, holding a doctoral degree of course bears several advantages which are possibly worth it to finish the doctorate before university spin-off foundation. For example, customers have a higher trust in the quality and reliability of the company and a doctoral degree can also open doors in practical ways.

High university status entrepreneurs like postdoctoral fellows and professors usually possess a high reputation. This makes it easier for them to gain legitimacy for the university spin-off. Yet these laurels in advance also oblige the academic entrepreneur to be more innovative and better than the competitors, as this professor refers: *"The professorial image helped me a lot at the beginning but of course it also commits me to do always more than my competitors. Of course I am expected to be a little more innovative, to perform a little bit better, have a bit*

better overview, and no standard concepts." (USO68). These high customers' expectations rapidly lead to high pressures. Furthermore, high status academic entrepreneurs usually think twice before founding a university spin-off, because they are afraid of putting their career and reputation at risk. This fear can also hinder high status academic entrepreneurs to become an entrepreneur with full commitment (see **Chapter 4.3**).

The majority of the university spin-offs of high status academic entrepreneurs are listed in the branch "scientific services", as mentioned before. This fact hinders the long-term growth of the companies because the economic success of the university spin-off is strongly dependent on the academic entrepreneur's university status and can hardly be transferred to other persons, as this quotation underlines: *"The only risk, which is the problem in our private institute, is the moment where I would be absent. The company is quite dependent on my person, my name and the university context. Therefore, it is hardly possible to say that the company would continue to exist without me in case I retire or so. It is an important factor that I have to appear everywhere. Even if my staff knows it better than I do, the people expect me to be there. Much is dependent on my image and the whole construct. I think it is continuing quite well as long as I am still fit." (USO68).* This fact is a severe uncertainty factor for long-term university spin-off growth.

The results of the content analysis with a special focus on the university status show that the reputation helps in terms of gaining legitimacy earlier. This is especially useful at the beginning of the university spin-off but in the long run this can develop to a disadvantage because university spin-off growth is highly dependent on the academic entrepreneur's university status. The hypothesis that especially high status entrepreneurs create high growth university spin-offs cannot be confirmed. It is rather important to decouple the university spin-off from the academic entrepreneur and the university in the long run to achieve high growth (see RASMUSSEN/BORCH 2010:607).

4.2 Results from Human Capital Perspective

In the following, I present the results concerning the second research question "Do rising human capital and resulting knowledge transfer have a diminishing marginal utility for university spin-off growth and may even develop to a disadvantage?" The focus is on human capital acquisition firstly in terms of scientific expertise and the resulting knowledge transfer and secondly in terms of additional management skills acquired in university.

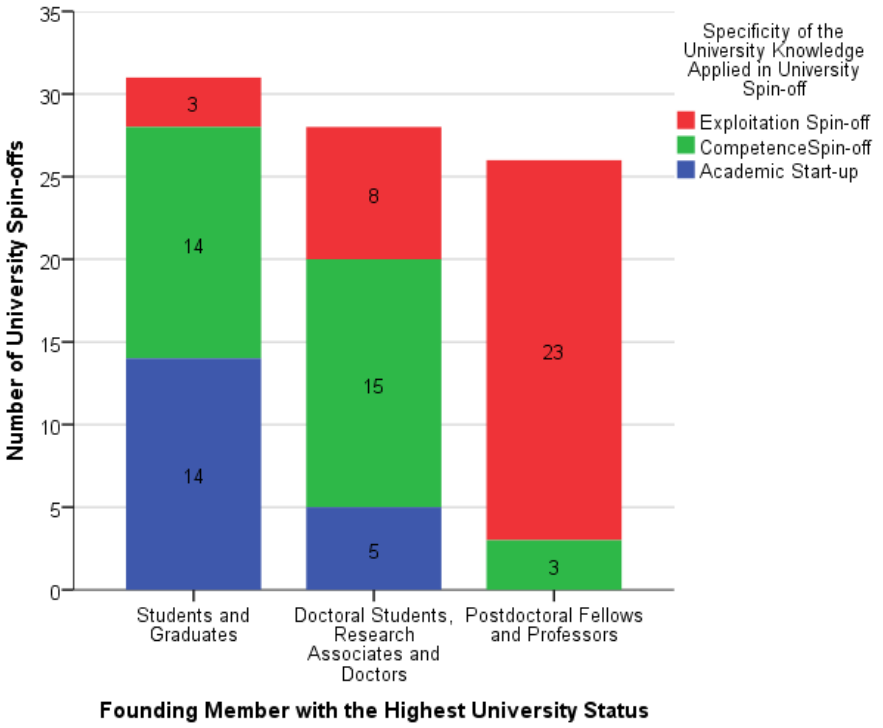
Students and graduates, who discover a market gap and decide to exploit it, usually start up a university spin-off on the basis of the knowledge he or she acquired during studies. Transferring research results into practice rather plays a minor role at this low university status. Sometimes results of the diploma thesis or content from the employment as a student assistant were implemented. However, in the majority of cases the identification of a market gap rather happened due to personal matters, social trends, experiences and contacts from part-time jobs, internships or voluntary work. In these university spin-offs, only basic competencies acquired in studies are of importance.

Doctoral students, research associates (without doctor's degree) and doctors acquire profound scientific expertise in a certain subject during doctoral studies and research projects. The majority of them discover a market gap due to their research activities. Projects with high practical relevance and close contact to industry partners have the highest potential to be transferred into practice and facilitate the market entry. Many doctoral students, research associates and doctors start up a university spin-off because the industry partners announce a concrete demand for the product developed in a research project. However, there are also a handful of doctoral students, research associates and doctors who set up a business only on the basis of basic competencies they acquired in their doctoral studies and research projects.

Postdoctoral fellows and professors possess extensive scientific expertise in different research subjects, because they did research for many years in a lot of different projects. The majority of them discover a market gap due to their research and consultant activities. Here too, industry contacts of course are very helpful and facilitate market entry.

Figure 3 shows the different characters of knowledge transfer and the number of university spin-offs for the respective university status. The results show, that the higher the university status the more scientific expertise is acquired and therefore the more university knowledge is transferred to the university spin-off. With advancing university status the trend is shifting from academic start-ups over competence spin-offs to exploitation spin-offs. However, a positive influence of the degree of university knowledge transfer into the university spin-off on university spin-off growth could not be determined for our sample. Positive extreme cases exist for both, university spin-offs based on the exploitation of research results as well as university spin-offs based on the application of competencies. The majority of the university spin-offs of postdoctoral fellows and professors are listed in the scientific service sector. This oftentimes hinders the long-term growth because the tacit knowledge applied and the

profound scientific expertise makes the company very dependent on the academic entrepreneur and can hardly be transferred to other persons.



Source: Own survey 2011.
Note: N = 75.

Figure 3: Knowledge Transfer and University Status

Beside scientific expertise academics gain also management skills in university which might be helpful for entrepreneurship as the interviewees reported. The skills which were mentioned varied according to the university status. In the following paragraphs some examples will be given.

Students and graduates do not only possess little scientific expertise but also only little working experience. Accordingly, they have only little experience in project management which is mostly based on student projects, internships, part-time jobs or diploma theses. In the early phase of the university spin-off, they have difficulties to estimate and control the complexity, duration and cost of customer orders. This often results in a high workload for them at certain times and in the worst case in a non-compliance with the time limit. This can lead to an order cancellation from the customer side and severe image damage. However, such initial problems are not serious in most of the cases, so that the university spin-offs have developed well, as this quotation of a student shows: *"Of course we only had quite little experience. Nobody of us was professionally experienced and of course we did not have a*

clue about how to start a firm. Everything was quite improvised, but it still worked anyway." (USO04). This quotation shows that a youthful easiness helps to get over initial difficulties.

Doctoral students, research associates and doctors have already acquired working experiences in university, which are valuable for the university spin-off as well. Many of them are already involved in the application, management and evaluation of research projects, as this quotation of a doctoral student shows: *„Before, I made my living at university by project applications, management, and evaluation. Actually, this is a skill, which I could bring to the company. I simply know where I have to look what kind of support offers exist. I am able to overview that quite quickly." (USO33).*

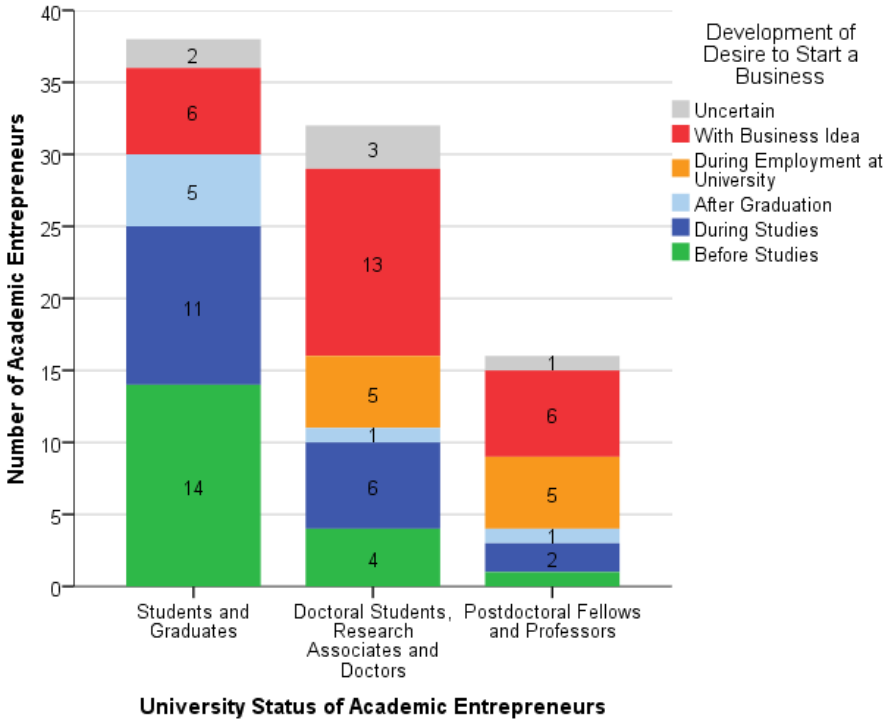
Beside the skills which are mentioned at lower university statuses, postdoctoral fellows and professors are usually responsible for staff. Therefore, they attain valuable skills in personal management as these postdoctoral fellow remarks: *"Fortunately, I had to do personal management, financial management and so on as a group leader. I had a group of 15 people and I was fully responsible in the scientific and financial way." (USO02).*

These additional skills acquired in university are certainly nice to have but they do not seem to be crucial for long-term university spin-off growth. The vast majority of the interviewees had to cope with a lack of business knowledge at the beginning. I could not identify a long-term advantage for academic entrepreneurs who already had prior management knowledge.

4.3 Results from Role Identity Perspective

In the following, I present the results concerning the third research question "Do difficulties with role identity change increase with advancing time in university and hinder university spin-off growth?" Therefore, I address statements of longstanding university staff deriving from difficulties in role identity change.

More than one quarter of our interviewees stated that they did not develop the desire to start a business until they had a concrete business idea. Before then they either never thought about becoming an entrepreneur or they even have not wanted to become an entrepreneur (see **Figure 4**). Especially for academic entrepreneurs with a high university status the desire for entrepreneurship only developed with the concrete business idea quite late in their university career and oftentimes also on demand from industry. This finding indicates that many academic entrepreneurs were not prepared emotionally and mentally for their new role, which can cause difficulties especially in the initial years.



Source: Own survey 2011.
Note: N = 86.

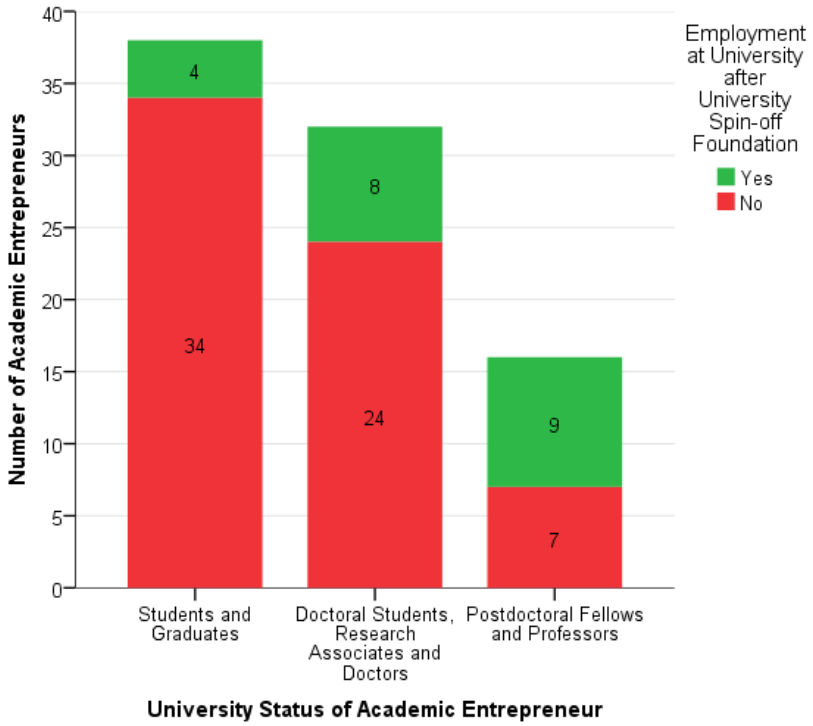
Figure 4: Development of the Desire to be Self-employed

For example, a professor reported that it is difficult for him to get used to the stress and workload that managing a university spin-off entails: *"I have to say that being self-employed means greater stress than being employed at the university. I would almost say twice as much (laughing). Well, our applied projects are of course not as complex as fundamental research, but we handle eight, nine, ten projects at the same time. Particularly, they all have a certain time schedule that we have to meet. It generates a huge pressure to do everything as expected. As a professor, I have also worked a lot. But it is something else when you simply say: 'That is a customer, who has to be served until a certain point. The results have to be presented and they have to be largely excellent.' With a professorship it is something else. They don't have the direct link of 'When I lose a customer, I will have less money next year'. For a professor this is completely different. Also the psychological pressure is not as high. If I screw something up as a professor, although nobody does it and nobody wants it and this harms my reputation, this does not affect my existence." (USO68).*

Another example for emerging difficulties due to different value systems between academia and the private sector is a lack of profit orientation. Individuals, who target a university career and already worked in university for long time, are usually not very profit oriented. They are rather driven by a scientific interest. This makes it difficult for them to run a university spin-

off in the initial period. It takes them a while before they learn to change their minds, as this professor vividly recorded: *"You should not be too much of a geek and scientist who becomes obsessed with fiddling and loses sight of his targets. A crucial turning point for me was a banker who asked me right after starting the business: 'Why have you started the business? What was your motivation?' I had to think about what to answer and things like self-fulfillment and having fun came to my mind. While I was thinking he said: 'Now don't start with self-fulfillment and it was so much fun. There is only one reason that you should have. Everything else doesn't count; otherwise you can pack up and go home. The only right to exist for a business is to earn money.' And he was right. It sounds so simple. In the beginning, it might also sound immoral, particularly if you tell this to a scientist. But he was right, I have to earn money. I have to evaluate everything I consider as a business man concerning whether something comes out of it at the end of the day or whether it is only a little fun." (USO41).*

Referring to the commitment to the entrepreneurial role the academic entrepreneurs in the sample can be divided into two groups. On the one hand there are academic entrepreneurs who wanted to change their role and broke up their university career for the university spin-off. On the other hand there are academic entrepreneurs who actually do not want to change roles and never leave university. Around one third of the academic entrepreneurs in the sample decided to continue their university career and work in the university spin-off at the same time on a part-time basis (see **Figure 5**). For one part of these individuals the university career serves solely to finance themselves in the initial years of business, but this career path can also be chosen because of opposite motives. For the other part of these individuals, the university career is the first choice. They never plan to be a full-time entrepreneur and leave university because they rather want to do research and teaching. The question then is, why these individuals startup a university spin-off at all. Individuals, who target a university career, view the university spin-off as a good opportunity either to finance their subsequent university career or to gain reputation as university professor later.



Source: Own survey 2011.
Note: N = 86.

Figure 5: Employment at University after University Spin-off Foundation

Many postdoctoral fellows in the sample decided to startup a university spin-off because they suffer from a lack of job security in university due to part-time and fixed-term contracts. Usually postdoctoral fellows have almost no experience in the private sector but at the same time they are highly qualified and possess a mature personality. This makes it very difficult for them to find a subsequent job in a dependent employment in the private sector in case their contracts are not extended or they do not find a professorial chair after habilitation. Therefore, they go on two separate tracks regarding their professional career. In the end, many of these kinds of academic entrepreneurs nevertheless stay in university in the long run and their university spin-offs remain small for that reason. In contrast, the few postdoctoral fellows who left university immediately after foundation or after a transitional period have good chances to establish big university spin-offs. Postdoctoral fellows who have discovered a market gap on the basis of their research projects and are growing disenchanted with the self-purpose of university research generally have a high growth potential because they are highly innovative and have a high commitment to their new role. However, a long development phase due to a low market maturity of the developed products or services oftentimes result in high financing needs and delays growth.

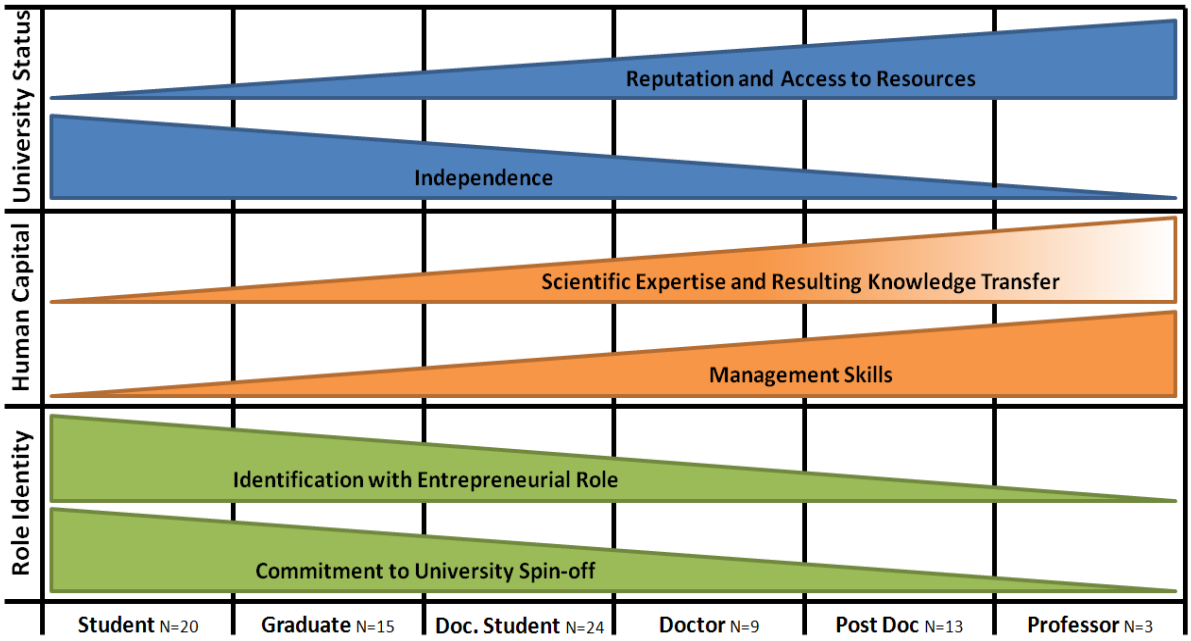
For the professors in the sample the university career is definitely at the first place and the university spin-off is rather a secondary employment. This lies in the nature of the chosen career paths. In engineering science professors usually start up a business because they can improve their reputation as well as research and teaching in this way. Therefore, most professors do not start a university spin-off with full commitment. It is much more often the case that professors are members of the founding team but rather to support the university spin-off with scientific advice, financial capital or reputation. Even if professors themselves generated the business idea they prefer to share the university spin-off with their employees, who then work with full commitment, as this doctor reports about sharing the university spin-off with his professor: *"We are three people in our company: Actually primarily me and the professor and another minority holding. I am actually alone responsible for the operating business and the rest is strategic advance, just put it this way." (USO48).*

The results of the content analysis show that the role identity change from being a scientist to being an entrepreneur is becoming more and more difficult with advancing time working in university. Especially postdoctoral fellows and professors reported in their interviews that they had trouble with it, whereas students and graduates who are at the beginning of the university career, hardly told about such problems. In contrast to management skills, the attitude towards entrepreneurship and adaption to a new value system are hard to learn. The socialization process, which takes place in university, should therefore not be underestimated. As a result, with advancing time in university and rising university status the commitment for the entrepreneurial role tends to decrease.

4.4 Summary of Results

The empirical findings show that every university status has certain potentials and challenges to cope with like summarized in **Figure 6**. With advancing university status the reputation of course increases, but at the same time the independence from university decreases. Scientific expertise and resulting knowledge transfer as well as management competencies rise with advancing university status. Nevertheless, the scientific expertise and the resulting knowledge transfer can develop to a disadvantage for long-term university spin-off growth. Only for the role identity change the results are quite clear: With advancing university status academic entrepreneurs have increased problems to change the roles and to lead the university spin-off with full commitment. Around one third of the academic entrepreneurs in the sample decided to continue their university career and work in the university spin-off at the same time on a part-time basis. These types of university spin-offs usually stay small. It is very important to

have at least one founding member who goes in the university spin-off with full commitment at least in the initial years.

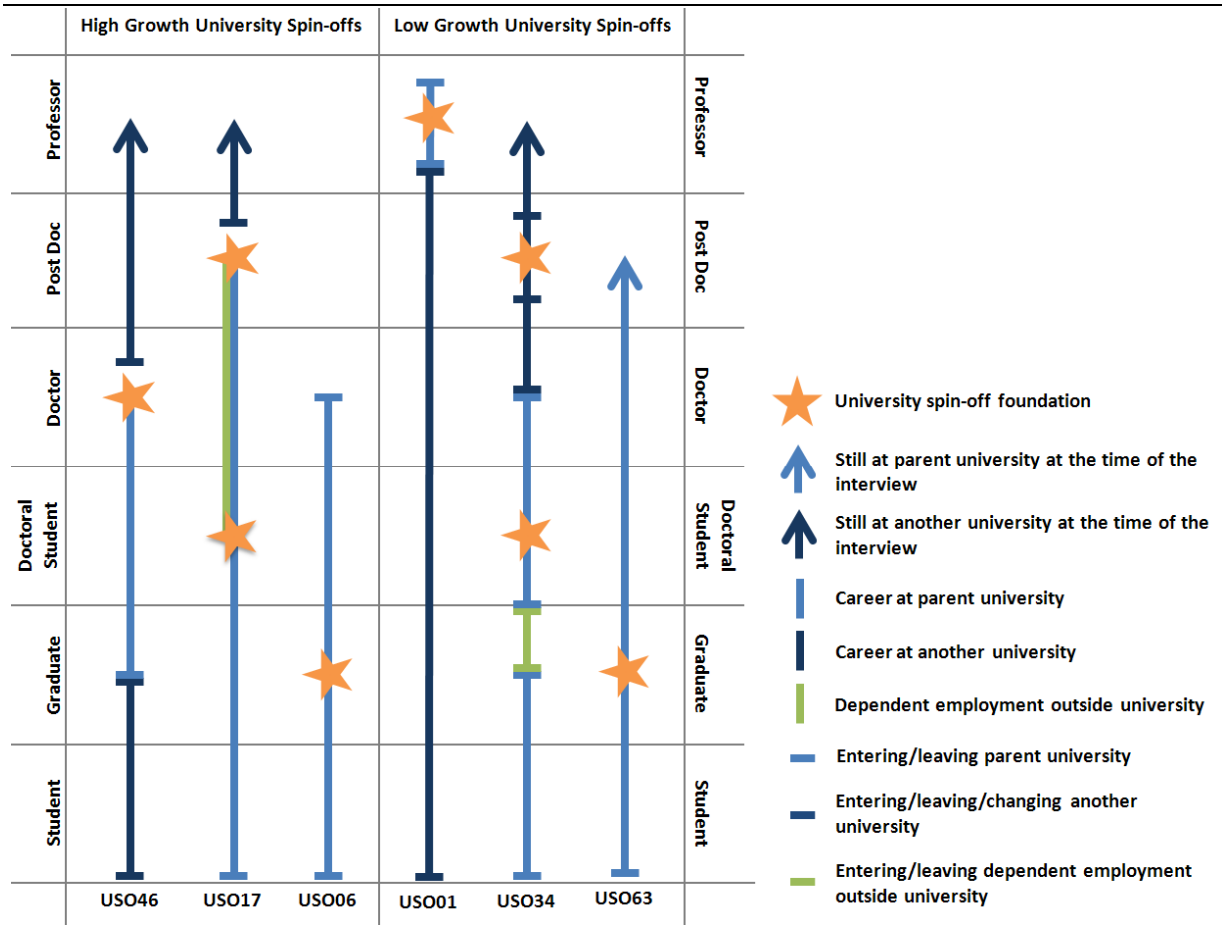


Source: Own illustration and survey 2011.
Note: Preliminary results of a content analysis. Fading color of the triangle "Scientific Expertise and Resulting Knwoledge Transfer" demonstrates diminishing marginal utility. In principle, missing advantages may be counted as disadvantages, but each advantage may also entail a respective disadvantage as explained in the text.

Figure 6: Advantages of University Statuses for University Spin-off Growth.

5 Results of Extreme Case Analysis

In this chapter I show the importance of and interaction between the three theoretical perspectives for selected cases. Therefore, I identified three positive and three negative extreme cases in the sample in terms of university spin-off growth measured as number of employees in 2011. I investigated their university career paths in depth in order to identify some patterns explaining the growth differences between high growth and low growth examples. They obviously vary considerably and it is clearly recognizable at a glance that a longer university career is not necessarily better for university spin-off growth (see **Figure 7**).



Source: Own illustration and survey 2011.
Note: Growth is measured by the average annual increase in employees from the year of university spin-off formation to 2011. Sampling Approach based on positive and negative extreme cases.

Figure 7: Academic Entrepreneurs' Career Paths

In order to explain the importance of the willingness of role identity change I compare the career paths of two academic entrepreneurs with the case numbers USO17 and USO34 (see Figure 7). The interviewees have pretty much in common at first glance. The two university spin-offs are founded in knowledge-intensive services and the academic entrepreneurs were still working at university as professors at the time of the interview. They have both made prior experiences in the private sector, on the one hand through prior self-employment and on the other hand through dependent employment. They founded their second university spin-off after finishing the doctoral degree, which brought advantages for them at the beginning, as this quotation shows: *„Of course my doctoral degree helped me solving practical problems like renting an office and convincing the landlord that I am absolutely able to pay the rent." (USO17).* Nevertheless the university spin-offs' growth differs vastly. The academic entrepreneur of the high growth university spin-off though left university when founding his second university spin-off. The decision to leave university was not quite voluntarily. He transferred a research project into the university spin-off and founded the university spin-off

and became a full time entrepreneur, because he had no future at his parent university at that time: *"When I founded the company, I have actually quit the scientific career for myself." (USO17).* Later he reports from the fear of risking his career: *"I was scared of how my life would continue. My parents were very concerned and very disappointed with my decision. I actually wanted to become a scientist and professor and they were scared that my career is ending now." (USO17).* After some years he established a large scientific service company and after all he decided to continue his university career and finish his habilitation. In contrast, the academic entrepreneur of the low growth university spin-off left university after graduation, but after a short time in the private industry he realized that he prefers to pursue a university career. Although he is shaped entrepreneurially by his family, he returned to university. He founded the two university spin-offs because they bring forward his university career. He never had the intention to leave university for being a full-time entrepreneur, although the demand situation would allow an expansion. *"If I do the controlling for large projects, I will get a lot of money, but this is rather craft work for me. That does not bring me forward as a professor. Consulting in large projects, the provision of expert opinions is what helps me professionally."(USO34).*

A similar situation applies to the academic entrepreneurs with the case numbers USO06 and USO63 (see **Figure 7**). The interviewee of the high growth university spin-off continued his university career by making his PhD for a few years after foundation in order to have a secure income during the initial years. *"We decided that I remain at university and my partner leads the company with full commitment, so that we try to ensure a certain seed funding this way. I got a regular salary at university, while my partner did not earn any money as a self-employed at that time. Therefore, we said that we share my salary." (USO06).* This way, he was also able to gain deeper knowledge and to expand his industry contacts. For the academic entrepreneur of the low growth university spin-off the opposite is the case. He founded the university spin-off right after his graduation in order to finance his university career and never wanted to be a full-time entrepreneur, as this quotation illustrates: *"I lead my company as a part time job and get money for that. It is nothing different than acquiring third party funding, because I see myself as a scientist in the first place here. I still write on scientific studies here." (USO63).* Obviously, the university spin-off is a means to an end for him. A university spin-off founded because of this reason will hardly become a big company. The data shows quite clearly that university spin-offs, which are not managed by at least one founding member with full commitment for at least in the initial years, usually stay small (see also **Figure 7**).

In order to explain the interaction and evolving disadvantages from scientific expertise, deriving knowledge transfer and university status I compare the academic entrepreneurs with the case numbers USO01 and USO46 (see **Figure 7**). The interviewees have in common that they founded exploitation spin-offs in the service sector. During their research projects they both acquired pretty much reputation and established a wide social network not only in the scientific community but also to partners in private economy and industry. USO01 was a reputable professor in engineering with many contacts to industry. He founded the university spin-off in the sector of scientific services on a concrete demand from one of his industry partners. He did it because he was a luminary in his field and he saw a possibility to finance his doctoral students by the university spin-off. The business was going well until he retired from university and the institute was closed. Even after many successful years on the market the dependency of the university spin-off on the institute, the professor's scientific expertise and university status is still so high that the continuation of the business or the sale of the university spin-off to another professor is just simply impossible. In contrast, the high growth academic entrepreneur USO46 acknowledges the danger of the dependence on university status and university. He founded the university spin-off after finishing his doctoral studies together with his professor in the consulting sector. At the beginning the professor's reputation helped him a lot, but the decoupling of the university spin-off from the university and his professor's reputation was very important for him. After some years on the market the professor retired progressively from the operative and even strategic business. The young doctor changed from the scientific role to the entrepreneurial role with full commitment. He managed the university spin-off on a full time basis and it has grown rapidly in its initial years. However, now the doctor received a call for a university chair. This will increase his reputation and financial situation. As a result, he plans to lead the university spin-off only on a part time basis in future. Although he was aware of the importance to decouple the university spin-off from the parent university, he now plans to link it with his new university chair. He states, that the employment increase will therefore most likely not be exceed 15 employees but he plans to raise outside funds though.

The examples of the selected extreme cases show that a comprehensive consideration reveals the complex interaction between the three perspectives and thus allows further insights on how processes occur in reality. Although the academic entrepreneurs with a high university status state that they had advantages from high reputation and their social network, these advantages are rather important in the initial years. With advancing time on the market a high university status and profound scientific expertise even bears some risks for university spin-

off growth. The decoupling of the university spin-off from the academic entrepreneur's university status seems to be very important for long term university spin-off growth in terms of employment increase. No less important is identification with the entrepreneurial role the willingness to manage the company with full commitment at least in the initial years.

6 Conclusion

Referring to the title of this paper it can be stated that longer university career is not necessarily better for subsequent university spin-off growth. The theoretical assumptions as well as the empirical results from the content analysis and extreme case analysis show that each university status comprises certain advantages and disadvantages. Academic entrepreneurs are located in a trade-off. A higher university status and therefore more scientific expertise are not necessarily advantageous for long-term university spin-off growth. Some examples exist where a high degree scientific expertise and resulting of knowledge transfer in connection with a high university status even develop to a disadvantage for university growth due to a high dependency on the academic entrepreneur and on university. The willingness and ability for role identity change in terms of the degree of commitment to the entrepreneurial role is very important.

On the basis of the results, the policy recommendation is that subsidies should not be dependent on a high degree of knowledge transfer or a high university status of the academic entrepreneur. Instead, it is of particular importance to consider academic entrepreneurs' university status and career plans, in order to compensate particular disadvantages at different university statuses and to recognize academic entrepreneur's growth intention. Furthermore, I recommend to support the formation of founding teams with complementary skills and university statuses (see BREITENECKER/SCHWARZ/CLAUSSEN 2011). Students and doctoral students usually have a high willingness to learn. This might diminish the cognitive distance between professors and management graduates (see NOOTEBOOM et al. 2007). The professor's scientific expertise will be coupled with the students' risk disposition and flexibility. The graduates therefore can profit from the professor's reputation and far-reaching social networks. Nevertheless there might also derive some problems. Disputes can arise due to an imbalance between the professor and the students. Due to the different university statuses collaboration at eye-level is difficult. A possible solution to avoid many problems in advance is to clarify the division of tasks and competence fields from the beginning. In the empirical study are some positive examples where professors are shareholders and scientific advisors,

but the operating business is performed by graduates, so that both sides can benefit from each other.

Further research should look at self-employment as part-time job for scientists. This phenomenon has been neglected in literature so far, although it might represent an untapped potential for the university and the region. Due to the fact that only a small minority of university spin-offs belong to the group of high flyers, it should be investigated what kind of alternative benefits, apart from employment and profit, derive from university spin-offs once for the region and once for the university. Especially in the German context this is of particular importance because German universities usually are not allowed to acquire shares in the university spin-offs, so that they have not a financial benefit from their university spin-offs.

References

BATHELT, H.; KOGLER, D. F.; MUNRO, A. K. 2010: A knowledge-based typology of university spin-offs in the context of regional economic development. In: *Technovation,* 30 (9-10), S.519-532.

BECKER, G. S. 1975: Human Capital : A Theoretical and Empirical Analysis, with Special Reference to Education. (2nd). New York: Columbia University Press.

BERNARD, H. R.; RYAN, G. W. 2009: Analyzing Qualitative Data: Systematic Approaches. Los Angeles et al.: Sage Publications, Inc.

BIRLEY, S.; WESTHEAD, P. 1994: A taxonomy of business start-up reasons and their impact on firm growth and size. In: *Journal of Business Venturing,* 9 (1), S.7-31.

BRAUN-THÜRMANN, H.; KNIE, A.; SIMON, D. 2010: Unternehmen Wissenschaft - Ausgründungen als Grenzüberschreitungen akademischer Forschung. Bielefeld: transcript Verlag.

BREITENECKER, R. J.; SCHWARZ, E. J.; CLAUSSEN, J. 2011: The influence of team heterogeneity on team processes of multi-person ventures: an empirical analysis of highly innovative academic start-ups. In: *International Journal of Entrepreneurship and Small Business,* 12 (4), S.413-428.

BUNDESAMT, S. 2013: Kleine und mittlere Unternehmen (KMU). https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/UnternehmenHandwerk/KleineMittlereUnternehmenMittelstand/KMUBegriffserlaeuterung.html. Abruf: 01.05.2013.

CASSAR, G. 2007: Money, money, money? A longitudinal investigation of entrepreneur career reasons, growth preferences and achieved growth. In: *Entrepreneurship and Regional Development,* 19 (1), S.89-107.

CHANDLER, G. N.; JANSEN, E. 1992: The founder's self-assessed competence and venture performance. In: *Journal of Business Venturing,* 7 (3), S.223-236.

COLIN MASON, S. T. A. S. C. 2011: Does education matter? The characteristics and performance of business started by recent university graduates. In: BORCH, O. J. (Hrsg): Entrepreneurship research in Europe: Evolving concepts and processes.

COLOMBO, M. G.; GRILLI, L. 2005: Founders' human capital and the growth of new technology-based firms: A competence-based view. In: *Research policy,* 34 (6), S.795-816.

CZARNITZKI, D.; RAMMER, C.; TOOLE, A. 2013: University spinoffs and the'performance premium'. In: *ZEW-Centre for European Economic Research Discussion Paper,* 13 (004).

DAVIDSSON, P.; ACHTENHAGEN, L.; NALDI, L. 2007: What do we know about small firm growth? In: (Hrsg): The life cycle of entrepreneurial ventures. Springer, S. 361-398.

DAVIDSSON, P.; HONIG, B. 2003: The role of social and human capital among nascent entrepreneurs. In: *Journal of Business Venturing,* 18 (3), S.301-331.

DING, W.; CHOI, E. 2011: Divergent paths to commercial science: A comparison of scientists' founding and advising activities. In: *Research policy,* 40 (1), S.69-80.

DÖRRE, K.; NEIS, M. 2010: Das Dilemma der unternehmerischen Universität: Hochschulen zwischen Wissensproduktion und Marktzwang. Berlin: edition sigma.

DRUILHE, C.; GARNSEY, E. 2004: Do academic spin-outs differ and does it matter? In: *The Journal of Technology Transfer*, 29 (3), S.269-285.

EGELN, J.; GOTTSCHALK, S.; RAMMER, C.; SPIELKAMP, A. 2002: Spinoff-Gründungen aus der öffentlichen Forschung in Deutschland: Kurzfassung; Gutachten für das Bundesministerium für Bildung und Forschung. In: *ZEW Dokumentationen*.

ERDÖS, K.; VARGA, A. 2012: The Academic Entrepreneur: Myth or Reality for Increased Regional Growth in Europe? In: ERDÖS, K.; VARGA, A. (Hrsg): Creative knowledge cities: myths, visions and realities. Cheltenham: Elgar, S. 157-181.

ETZKOWITZ, H. 2008: The Triple Helix. University-Industry-Government. Innovation in Action. Madison, NY: Routledge.

GARNSEY, E. 1998: A theory of the early growth of the firm. In: *Industrial and Corporate Change*, 7 (3), S.523-556.

GIBCUS, P.; STAM, E. 2012: Firm resources, dynamic capabilities, and the early growth of firms. In: *Scales Research Reports, EIM Business and Policy Research*, H201219.

GLÄSER, J.; LAUDEL, G. 2009: Experteninterviews und qualitative Inhaltsanalyse: Als Instrumente rekonstruierender Untersuchungen VS Verlag.

HAYTER, C. 2010: In search of the profit-maximizing actor: motivations and definitions of success from nascent academic entrepreneurs. In: *The Journal of Technology Transfer*, 36 (3), S.340-352.

HELM, R.; MAURONER, O. 2007: Success of research-based spin-offs. State-of-the-art and guidelines for further research. In: *Review of Managerial Science*, 1 (3), S.237-270.

JAIN, S.; GEORGE, G.; MALTARICH, M. 2009: Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. In: *Research policy*, 38 (6), S.922-935.

KLOFSTEN, M.; JONES-EVANS, D. 2000: Comparing Academic Entrepreneurship in Europe – The Case of Sweden and Ireland. In: *Small Business Economics*, 14 (4), S.299-309.

KODITHUWAKKU, S. S.; ROSA, P. 2002: The entrepreneurial process and economic success in a constrained environment. In: *Journal of Business Venturing*, 17 (5), S.431-465.

KOLVEREID, L. 1992: Growth aspirations among Norwegian entrepreneurs. In: *Journal of Business Venturing*, 7 (3), S.209-222.

LAWTON SMITH, H. 2007: Universities, innovation, and territorial development: a review of the evidence. In: *Environment and Planning C: Government & Policy*, 25 (1), S.98-114.

LAWTON SMITH, H.; HO, K. 2006: Measuring the performance of Oxford University, Oxford Brookes University and the government laboratories' spin-off companies. In: *Research policy*, 35 (10), S.1554-1568.

LAZEAR, E. P. 2005: Entrepreneurship. In: *Journal of Labor Economics*, 23 (4), S.649-680.

MANGEMATIN, V. 2000: PhD job market: Professional trajectories and incentives during the PhD. In: *Research policy*, 29 (6), S.741-756.

MAYRING, P. 2008a: Die Praxis der Qualitativen Inhaltsanalyse Beltz.

MAYRING, P. 2008b: Qualitative Inhaltsanalyse: Grundlagen und Techniken Beltz.

MILES, M. B.; HUBERMAN, A. M. 1994: Qualitative data analysis: An expanded sourcebook Sage Publications, Incorporated.

MÜLLER, B. 2006: Human capital and successful academic spin-off. In: *ZEW Discussion Paper*.

MURRAY, K. B.; HÄUBL, G. 2007: Explaining Cognitive Lock-In: The Role of Skill-Based Habits of Use in Consumer Choice. In: *Journal of Consumer Research*, 34 (1), S.77-88.

MUSTAR, P.; WRIGHT, M.; CLARYSSE, B. 2008: University spin-off firms: lessons from ten years of experience in Europe. In: *Science and Public Policy*, 35 (2), S.67-80.

NOOTEBOOM, B.; VAN HAVERBEKE, W.; DUYSTERS, G.; GILSING, V.; VAN DEN OORD, A. 2007: Optimal cognitive distance and absorptive capacity. In: *Research policy*, 36 (7), S.1016-1034.

NORBERT SZYPERSKI; KLANDT, H. 1981: Wissenschaftlich-technische Mitarbeiter von Forschungs- und Entwicklungseinrichtungen als potentielle Spin-off-Gründer. Eine empirische Studie zu den Entstehungsfaktoren von innovativen Unternehmungsgründungen im Lande Nordrhein-Westfalen. Opladen: Westdeutscher Verlag.

NÖRR, M. 2010: Spin-Offs: Wie Wissenschaftler zu Unternehmern werden. Anforderungen an den Gründer und das Transferobjekt. Hamburg: Diplomica Verlag Gmbh.

PARKER, S. C. 2005: The Economics of Entrepreneurship: What we know and what we don't now publishers Inc.

PHILLIPS, D. J.; ZUCKERMAN, E. W. 2001: Middle-Status Conformity: Theoretical Restatement and Empirical Demonstration in Two Markets. In: *American Journal of Sociology*, 107 (2), S.379-429.

PIRNAY, F.; SURLEMONT, B.; NLEMVO, F. 2003: Toward a Typology of University Spin-offs. In: *Small Business Economics*, 21 (4), S.355-369.

RAPPERT, B.; WEBSTER, A.; CHARLES, D. 1999: Making sense of diversity and reluctance: academic-industrial relations and intellectual property. In: *Research policy*, 28 (8), S.873-890.

RASMUSSEN, E. 2011: Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories. In: *International Small Business Journal*, 29 (5), S.448-471.

RASMUSSEN, E.; BORCH, O. J. 2010: University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. In: *Research policy*, 39 (5), S.602-612.

ROBERTS, E. B.; MALONE, D. E. 1996: Policies and structures for spinning off new companies from research and development organizations. In: *R&D Management*, 26 (1), S.17-48.

SAXENIAN, A. 1983: The Genesis of Silicon Valley. In: *Built Environment*, 9, S.7-17.

SCHMUDE, J.; AEVERMANN, T.; HEUMANN, S. 2011: Vom Studenten zum Unternehmer: Welche Universität bietet die besten Chancen? Ludwig-Maximilians-Universität München, Lehrstuhl für Wirtschaftsgeographie und Tourismusforschung.

SCHREIER, M.; NADERER, G.; BALZER, E. 2007: Qualitative Stichprobenkonzepte. In: NADERER, G.; BALZER, E. (Hrsg): Qualitative Marktforschung in Theorie und Praxis. Wiesbaden: Gabler, S. 231-245.

SHANE, S. A. 2004: Academic entrepreneurship: University spinoffs and wealth creation. Cheltenham (UK), Northampton (MA, USA): Edward Elgar Publishing.

SMILOR, R. W.; GIBSON, D. V.; DIETRICH, G. B. 1990: University spin-out companies: Technology start-ups from UT-Austin. In: *Journal of Business Venturing*, 5 (1), S.63-76.

STEPHAN, P.; LEVIN, S. 1996: Property rights and entrepreneurship in science. In: *Small Business Economics*, 8 (3), S.177-188.

STERNBERG, R. 1995: Technologiepolitik und High-Tech Regionen: Ein internationaler Vergleich. Münster: LIT Verlag.

STÜTZER, M. 2010: Human capital and social capital in the entrepreneurial process, Wirtschaftswissenschaftlichen Fakultät, Friedrich-Schiller-Universität Jena, Jena.

VOHORA, A.; WRIGHT, M.; LOCKETT, A. 2004: Critical junctures in the development of university high-tech spinout companies. In: *Research policy*, 33 (1), S.147-175.

WENNBERG, K.; WIKLUND, J.; WRIGHT, M. 2011: The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs. In: *Research policy*, 2011 (40), S.1128– 1143.

WENTLAND, A.; KNIE, A.; SIMON, D. 2011: Warum aus Forschern keine Erfinder werden: Innovationshemmnisse im deutschen Wissenschaftssystem am Beispiel der Biotechnologie. In: *WZBrief Bildung, Wissenschaftszentrum Berlin für Sozialforschung*, 17.

WIKLUND, J. 1998: Small firm growth and performance: Entrepreneurship and beyond. Jönköping: Internationella Handelshögskolan.

ZHANG, J. 2009: The performance of university spin-offs: an exploratory analysis using venture capital data. In: *The Journal of Technology Transfer*, 34 (3), S.255-285.