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Career paths and job creation of academic entrepreneurs in Germany

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Abstract

STATE-OF-THE-ART

Universities are often seen as engines for regional innovation and economic growth (see ETZKOWITZ 2008). The innovation potential of university spin-offs especially through "brain transfer" is widely acknowledged. This does not necessarily mean that every single university technology cause a university spin-off which becomes a global leader (see SHANE 2004). Especially at mid-range universities outside high-tech clusters, university spin-offs are rather rare entities with sometimes only minimal levels of job creation (see HARMON et al. 1997; DEGROOF/ROBERTS 2004).

RESEARCH GAP

Yet, only few scholars note that the potential for growth varies between university spin-offs not least because of the academic entrepreneurs' individual skills and attitudes. In this paper, I examine academic entrepreneurs' career paths and their effects on university spin-off job creation. In order to distinguish high potential from low potential university spin-offs, it is important to understand the interaction of the academic entrepreneur's scientific expertise, entrepreneurial qualification and motivation which is influenced by the individual career path. Based on theoretical arguments I want to investigate if there is a favourable time in the academic entrepreneur's career to startup a university spin-off with prospects of high job creation.

THEORETICAL ARGUMENTS

Every individual has a certain set of skills. While employees can be specialists in their fields entrepreneurs should combine different talents (see LAZEAR 2005). Therefore, the entrepreneur's human capital is seen as one important driver for firm's growth (see MÜLLER, B. 2006). If these results are transferred on academic entrepreneurs there obviously exists a tradeoff. With advancing years in university the academic entrepreneur might gain scientific expertise but at the same time cannot develop or even lose entrepreneurial qualifications (see MÜLLER, K. 2009). The scientific expertise acquired during the academic career paths might mislead the entrepreneurial activity. Researchers are specialists in their fields. If they transfer their academic habits into their new role as an entrepreneur, they might miss to orientate towards the market, to force economic success through identifying buyers and making marketing (see NÖRR 2010).

METHOD

Our analysis is based on qualitative survey data from two German midrange universities. We carried out a total of 85 semi structured face-to-face and telephone interviews with academic entrepreneurs during the period September 2011 to January 2012. The analytical process relied on a content analysis with the qualitative data analysis software NVivo.

RESULTS

The majority of university spin-offs only follows moderate growth perspectives and creates few jobs. The often cited 'gazelles' are rather extreme examples and do not necessarily match with the reality. In our study the majority of the academic entrepreneurs apparently do not want to achieve rapid growth but rather rely on organic growth. Nevertheless, I identified eight exceptionally large university spin-offs. By investigating the academic entrepreneurs' career paths in-depth it becomes obvious that every step in the university career path comprises certain qualifications and challenges to cope with. At a young age people are still more flexible, independent and keen to learn. With the advance of the university career these characteristics are reduced and at the same time scientific expertise, management experience, social networks and reputation rise. Obviously, these circumstances show a trade-off. With the passing of time in university, academics both gain and miss certain skills which are important for being a successful entrepreneur. Apart from the skills the academic entrepreneur's motivation to startup a university spin-off plays an important role. Many academic entrepreneurs rather prefer to have small companies, because then they still have enough time to work on the scientific content instead of managing distribution or personnel. The scientific work is often seen as the main objective and not so much the profit maximization. The favourable time in the academic's career path for university spin-offs with high job creation is probably during and after completing doctorate studies. This step in the university career path combines a high scientific expertise and entrepreneurial qualifications. It is also important to take into account the academic entrepreneur's motivation to start up a university spin-off. These considerations cannot guarantee the identification of successful entrepreneurs in advance, but they might increase at least the probability.?

Career paths and job creation of academic entrepreneurs in Germany

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Abstract

In order to distinguish high growth from low growth university spin-offs, it is important to understand the interactions of the academic entrepreneur's scientific expertise, entrepreneurial competence and challenges. These are influenced by the academic entrepreneur's career path. Based on theoretical arguments I investigate how the academic entrepreneurs' career paths can affect university spin-off growth in terms of job creation. My empirical results show that the character of knowledge transfer, which is based on the human capital acquired in university, is far from being the only decisive factor for university spin-off growth. Generally, during their university career, academic entrepreneurs find themselves in a trade-off between scientific expertise and entrepreneurial competencies which comprises potentials and challenges. As a result, the key for understanding university spin-off growth lies in the academic entrepreneur's individual career decisions, also after the university spin-off foundation.

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. One famous example is the internet search engine Google founded by Stanford University PhD Students (see SHANE 2004). Yet, this does not necessarily mean that every single university technology causes a university spin-off which becomes a global leader. Especially at mid-range universities outside high-tech clusters, university spin-offs are rather rare entities with sometimes only minimal levels of job creation (see HARMON et al. 1997; DEGROOF/ROBERTS 2004).

The literature suggests that the entrepreneur's human capital is one important driver for firm growth (see MÜLLER, B. 2006). Yet so far, it has not been analyzed how the human capital of entrepreneurs

interacts with his individual career path. While employees can be specialists in their fields, entrepreneurs should combine different talents (see LAZEAR 2005). Academic entrepreneurs therefore find themselves in a trade-off. With advancing years in university, the academic entrepreneur might gain scientific expertise but at the same time cannot develop important entrepreneurial qualifications (see MÜLLER, K. 2009). Furthermore, the scientific expertise acquired during the academic career paths might mislead the entrepreneurial activity. Researchers are specialists in their fields. If they transfer their academic habits into their new role as an entrepreneur, they might miss to orientate towards the market, to force economic success through identifying buyers and making marketing (see NÖRR 2010).

In this paper, I investigate how the academic entrepreneurs' career paths can affect university spin-off growth in terms of job creation. My analysis is based on qualitative survey data from two German midrange universities in which the majority of university spin-offs creates only few jobs while the often cited "gazelles" are rather extreme examples. I carried out a total of 85 semi structured face-to-face and telephone interviews with academic entrepreneurs during the period September 2011 to January 2012. The analytical process relied on a content analysis with the qualitative data analysis software NVivo. I show that, in order to distinguish high growth from low growth university spin-offs, it is important to understand the interactions of the academic entrepreneur's scientific expertise, entrepreneurial competence and challenges. These in turn, are highly influenced by decisions made by the academic entrepreneur during his career, before and after starting the business. By investigating the academic entrepreneurs' career paths in-depth, it becomes clear that every step in the career path comprises certain qualifications to benefit from and challenges to cope with.

These findings contribute to a better understanding of the factors which influence university spin-off growth and can help to improve university spin-off support by combining founders with different ideas on how to continue their career.

2 Determinants in the Academic Entrepreneur's Career Path for University Spin-off Growth

HEMER et al. (2007:59) empirically identified numerous determinants for spin-off success and categorized them to five spheres of influences: the personal, the company-specific, the environmental, the politico-legally and the transitory sphere. Empirical evidence exists regarding the influence of personal characteristics on job creation and innovation when founding a company. *"Personal characteristics of entrepreneurs, and especially their motivations and work experiences, are therefore relevant factors in the study of entrepreneurship, since they will lie behind the supply side of*

entrepreneurial activities and will have to be closely identified in any public policies orientated to promote such activities.” (LAFUENTE/SALAS 1989:18). Therefore, I will focus my study on the personal sphere.

A central factor concerning the academic career path is the advancing age of the founder (see FRITSCH/KRABEL 2012). Academic life cycle models suggest that scientists start a business at a later stage of their career after achieving important academic milestones (see SHANE 2004:159). This argument also received empirical support (see KLOFSTEN/JONES-EVANS 2000). In the existing literature, the results on the influence of the academic entrepreneur’s age on venture growth are ambiguous. With advancing age, the experience and the savings are higher but also the risk aversion increases because of securing retirement income (see ARVANITIS/STUCKI 2012). With advancing time at university it is also likely that academics are climbing the hierarchy. In Anglo-American literature the rising university status, especially being a star scientist, is related to a higher credibility and therefore a better access to resources, which are necessary for establishing a company (see SHANE 2004:160 f.). In contrast, some empirical studies 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 competences. Therefore, the sales productivity is quite low in the first years. Secondly, standardization and economies of scale are difficult to achieve (see EGELN et al. 2002:57). Therefore, a concave relationship between academic entrepreneur’s age and university spin-off’s success can be assumed.

During the career path, which is inevitably related to the advancing age, the individual human capital also increases. Human capital theory says that individuals are endowed with skills and knowledge (see BECKER 1975). Individuals can increase their overall knowledge through investments in their human capital like schooling, on-the-job-training, searching for information, etc. (see BECKER 1975). These investments improve their productivity at work and result in higher wages. In the field of entrepreneurship, investments in human capital also lead to an advantage in terms of company’s survival, growth and profitability (see SHANE 2004:240; STÜTZER 2010:25).

Human capital is usually classified into general and specific human capital (following BECKER 1975), where general human capital is aligned to formal education and working experiences while specific human capital is based on industry knowledge and entrepreneurial experiences (see MÜLLER, K. 2009:7). Empirical studies show that especially labor market, management and prior entrepreneurial experience positively influence entrepreneurial activity. Based on the human capital theory and the empirical results it can be concluded that the longer a person works in university the more knowledge he or she acquires and the higher the entrepreneurial activity and venture growth. Also,

the higher the education and scientific experience, the higher is the knowledge transfer and innovation potential of the university spin-off (see ARVANITIS/STUCKI 2012).

Regarding the academic career path, university spin-off founders can be generally distinguished in students with less scientific background and researchers like doctoral students, scientific staff and professors. There are, however, some studies who only consider researchers as university spin-off founders (see for example SMILOR/GIBSON/DIETRICH 1990). Usually one can expect that scientists' spin-offs are based on extensive research activities oftentimes with industrial partners while students' spin-offs rather exploit business opportunities. It can be supposed that university spin-offs according to this distinction vary not only in terms of innovation potential but also in terms of business growth (see PIRNAY/SURLEMONT/NLEMVO 2003). This means that the long standing scientific staff, for example professors, has the highest potential to produce knowledge intensive, highly innovative and fast growing spin-off companies. Of course, increasing knowledge and scientific reputation certainly support university spin-off growth. For example, the company can acquire credibility more easily (see VOHORA/WRIGHT/LOCKETT 2004).

Many empirical studies confirm a positive relationship between education and entrepreneurial activity and venture growth (see PARKER 2005:320) but contradictory results exist (see DAVIDSSON/HONIG 2003). Individual's career choices also include attitudes towards entrepreneurship. 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 and company's success cannot be considered automatically, because at a certain point in time the danger of a cognitive lock-in might develop (see MURRAY/HÄUBL 2007).

LAZEAR (2005) differentiates between employees and entrepreneurs. Every person possesses a certain set of skills. 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 expert knowledge in their field, but this kind of knowledge alone is not sufficient. Business knowledge and prior entrepreneurial experience are also important for establishing a successful university spin-off (see SHANE 2004:161, 241). Business knowledge comprises management knowledge as well as knowledge of product development, production and markets. In many cases, academic entrepreneurs suffer from a lack of business knowledge because in their academic careers they have mainly focused on developing scientific expertise. Some academic entrepreneurs therefore need external business competence to be more successful (SHANE 2004:241 f.).

The previous paragraphs already indicate that the acquired knowledge during the academic career paths might even mislead the entrepreneurial activity. Therefore, founding a university spin-off might be exposed to respective challenges. 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. 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).

The factors discussed above indicate, that researchers 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 researchers' and entrepreneurs' attitudes and behaviors. The respective mentality is firmly anchored in their minds and cannot be easily changed. This means that researchers 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. 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, they have another entrepreneurial attitude than students or doctoral students, who might have never planned to work for the university much more years and who did not internalize the university value system in such intensity. Therefore, it can be generally expected, that doctors and professors have a lower entrepreneurial and profit orientation (see DING/CHOI 2011) and therefore might create university spin-offs with less growth potential.

However, the career path does not come to an end by founding a university spin-off. Another factor in the career path of academic entrepreneurs regarding venture growth has to be considered. Empirical evidence exist that it is important whether the founder has left university for setting up a company or not (see PIRNAY/SURLEMONT/NLEMVO 2003; SHANE 2004:249). Students and researchers who are still affiliated with university often head the company only on part-time base. On the one hand, this bears the risk of reducing personal commitment and thereby growth expectations (see EGELN et al. 2002:37, 55 f.). On the other hand, the strong relationship with university can be important for university spin-offs' success in research-intensive sectors.

3 Conceptual Framework

In the conceptual discussion several important factors for university spin-off growth in the academic entrepreneurs' career paths were identified. The main elements of the theoretical background are summarized in **figure 1**. The focus is on the academic entrepreneur's career path which entails the individual human capital, which can be divided into expert knowledge on the one hand and entrepreneurial competencies on the other hand. Furthermore, the academic entrepreneur's career path can lead to challenges resulting from opposite value systems between university and industry.



Figure 1: Conceptual Framework.

Source: Own illustration.

Two research questions will be addressed in the empirical part of this paper. Firstly, I investigate how the character of knowledge transfer into the university spin-offs varies between companies started at different academic career levels. Secondly, I analyze how the level of knowledge transfer and different career paths of academic entrepreneurs can influence university spin-off growth in terms of job creation.

In this paper I focus on the differences in the academic entrepreneurs' human capital, entrepreneurial competencies and challenges of different career levels. Therefore I do not go into detail regarding qualifications and challenges which all my interviewees have in common. Generally all the university spin-offs in my sample are knowledge intensive. A relatively high amount of human capital can be assumed for all academic entrepreneurs in my sample. Independently from the academic career level, there are academic entrepreneurs in the sample who have prior entrepreneurial experiences. These multiple founders of course have huge advantages. However, the vast majority of my 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 customer demand. Many academic entrepreneurs of all career levels had to cope with problems in entering the market.

4 Data and methods

4.1 Defining University Spin-offs

Following PIRNAY et al. (2003) and SMILOR et al. (1990) I define university spin-offs as new companies founded by at least one researcher, staff member, or student who left the university to start a company or who founded (or co-founded with others) the company while still affiliated with the university to exploit knowledge and/or skills produced by academic activities in a profit-making perspective. In contrast to some other authors who only include technology-oriented university spin-offs in their studies (see for example SMILOR/GIBSON/DIETRICH 1990), I also take into account knowledge intensive service companies (see for example also RAPPERT/WEBSTER/CHARLES 1999).

Considered are 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). 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 founder may have gained significant knowledge in his/her time in employment beyond the university. However, I consider that, especially in high-tech sectors, a sufficient time period is necessary for setting up a company. Based on this rather broad definition, university spin-offs vary concerning the level of the founders' academic career level and consequently also concerning their scientific expertise and knowledge transfer potential.

4.2 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.

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 career levels divided into two basic categories: student or scientific staff. The cases were equally distributed throughout each possible combination of the expressions of those characteristics.

4.3 Data Sources

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 I had informal discussions with leaders of the technology transfer offices (TTO's) and employees of different economic development agencies in my two survey regions Hannover and Göttingen. In avoidance of a bias for the benefit of university spin-offs which used advice on funding and financing matters, I also asked the heads of all institutes of the two universities for information about university spin-offs by mail. Furthermore, I 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 I collected by e-mail and further internet search. In many cases I still did not know if they are academic entrepreneurs according to my definition. In total, I obtained a list of 328 academic entrepreneurs of both universities. From this population a sample of 201 founders was contacted via e-mail, telephone and XING, of which 116 were unresponsive or did not agree to an interview.

In the third step of data collection, I carried out a total of 85 semi structured face-to-face and telephone interviews¹ (see BERNARD/RYAN 2009:29 ff.) with at least one member of the academic entrepreneurs' team during the period September 2011 to January 2012. The face-to-face interviews mostly took place in the respective company² and ranged from 45 minutes to two and a half hours in length. The vast majority of interviews was openly recorded and directly transcribed³. Throughout my interviews, I 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.

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.

4.4 Data Coding and Analysis

The analytical process relied on a content analysis (see MAYRING 2008b, 2008a; GLÄSER/LAUDEL 2009) which was supported by the qualitative data analysis software NVivo.

In order to differentiate different academic career levels I developed six categorizations, which show the academic career level of every person at the time of the university spin-off creation. The different academic career levels 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 most cases the person is working on habilitation. (6) “Professors” including private lecturer, adjunct professors and emeriti. In this category the persons have finished habilitation. Another important factor in the career path of academic entrepreneurs regarding venture growth is considered in the coding process: whether the founder has left university for setting up a company or not (see PIRNAY/SURLEMONT/NLEMVO 2003; SHANE 2004:249).

Regarding the character of knowledge transferred, I use a categorization based on the degree of specificity of the university knowledge applied (see BATHELT/KOGLER/MUNRO 2010; EGELN et al. 2002). I distinguish exploitation spin-offs, competence spin-offs and academic start-ups (see EGELN et al. 2002), which also makes it possible to predict the innovation potential (see [table 1](#)). Exploitation spin-offs are based on concrete research results or novel methods, which at least one founder has developed at university. These kinds of spin-offs have a very large innovation potential. Competence spin-offs emerged from specific knowledge or skills, which at least one founder has acquired in university. The founder’s specific competency enables him or her to develop the original idea further, oftentimes even independently from university. This type of university spin-off contains a medium level of innovation potential. By contrast, academic start-ups comprise only generic knowledge or skills, which at least one founder has acquired in university. Usually firms of this category only have a limited innovation potential. I do not differentiate between tacit and codified knowledge (see PIRNAY/SURLEMONT/NLEMVO 2003). This distinction is less suitable for my study because a clear distinction between tacit and codified knowledge is difficult to implement in reality. In fact, most spin-offs involve both tacit and codified knowledge.

5 Academic Entrepreneur's Human Capital and the Character of Knowledge Transfer

In this chapter I analyze how the character of knowledge transfer into the university spin-offs varies between companies started at different academic career levels and whether this influences subsequent spin-off growth (research question 1). **Table 1** shows the different characters of knowledge transfer with example quotations and the number of university spin-offs in the respective academic career level. It is clear to see, that with advancing academic career level the trend is shifting from academic start-ups over competence spin-offs to exploitation spin-offs. The reasons for this trend are explained in the following paragraphs.

| Character of Knowledge Transfer | Highest Academic Career Level held by one of the Founding Members (Number of University Spin-offs) | | | In Total |
|--|--|---|--------------------------|----------|
| | Students and Graduates | Doctoral Students and Research Associates | Post Docs and Professors | |
| Academic Start-up <i>„The science, which you learn in university, does not work out in reality. It must be clearly said. But I learned a good thing in university and this is the way of learning. That is very good.” (USO03).</i> | 14 | 5 | 0 | 19 |
| Competence Spin-off <i>“The know-how what the people need to provide the customers with professional advice and all the techniques, that is if course something which the study have made possible. To manage to gain a foothold in the sector is almost only possible if one is accustomed to this field, because one can understand the people, how they think, what they need. Only then one can really support them and provide service not only the pure technique. In this respect it would have been very difficult in any case without this basis.” (USO54).</i> | 15 | 14 | 3 | 32 |
| Exploitation Spin-off <i>„We worked on certain bacteria at the institute when we realized that the diagnostically opportunities in this field are only limited. Therefore, we would have wished that there would exist more opportunities. For one thing to have the service, for another thing that there are also tests available. And then the idea was born due to the recognized lack and the fact that we worked on that.” (USO28).</i> | 3 | 8 | 23 | 34 |
| In Total | 32 | 27 | 26 | 85 |

Table 1: Knowledge Transfer and Academic Career Level.

Source: Own survey 2011.

Students and graduates are rather at the beginning of their academic career. Nevertheless, some of them discover a market gap and decide to exploit it. The typical case is that a student or graduate

starts 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 early academic career level. 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 competences acquired in studies are of importance.

Doctoral students, research associates (without doctor's degree) and doctors are at the middle level of their academic career. During doctoral studies and research projects they acquire profound expert knowledge in a certain subject. 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. Many doctoral students, research associates and doctors start up a business because the industry partners announce a concrete demand for the product developed in a research project. However, there are also 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.

Beside expert knowledge, doctoral students, research associates and doctors have acquired additional skills in university. Many of them are already involved in the application and management of research projects. These skills are valuable for the university spin-off as well, 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).*

Post Docs and professors are at a high level of the academic career path. They possess extensive expert knowledge 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.

Beside the skills which are mentioned at the lower academic career levels, post docs and professors are usually responsible for staff. Therefore, they attain valuable skills in personal management as this post doc 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).*

The majority of the university spin-offs of post docs and professors are listed in the branch “scientific services”. This fact hinders the long-term growth of the companies because for companies in the scientific service sector it is not worthwhile to grow endlessly due to the fact that the companies are

very person-specific. The tacit knowledge applied and the founder's scientific reputation makes the company very dependent on the founder. This of course bears some risks. The economic success of the company is strongly dependent on the founder and can hardly be transferred to other persons. Under these circumstances it is difficult for the founder to find an appropriate successor: *"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 private institute 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). Also, the possibility of selling the company one day is difficult for academic entrepreneurs with a high reputation: *"I don't think that a sale makes any sense in our case or is realistic anyway, because the company is very, very dependent on my person. It is not like establishing the company until a certain size and then saying, now I can pass it to another firm and do something totally different. That would not work."* (USO52). This fact is an uncertainty factor for long-term economic growth.

The results show, that the longer an academic entrepreneur was at university, the more expert knowledge he or she acquired and therefore the more knowledge is transferred to the university spin-off. BATHELT et al. (2010) assume that the character of knowledge transfer also allows to make predictions concerning the individual growth potential and regional development. Yet, one should be cautious with an outlook on the spin-offs' growth potential. As the next chapter will show, this is not only determined by innovation potential but also by individual career paths.

6 Academic Entrepreneurs' Career Paths and Prospects of University Spin-off Growth

In general and especially in the USA, the main assumption is that university spin-offs are more innovative and therefore grow faster than other start-up companies. Nevertheless, theoretical and empirical evidence on job creation of university spin-offs is sparse. In Germany, HEMER et al. (2006:8) came to the conclusion: The majority of university spin-offs only follow moderate growth perspectives. The often cited "Stars, Gazelles or High-Flyers" are rather rare extreme positive examples and do not necessarily match with the reality. **Figure 2** shows the number of employees working in every single university spin-off in my sample depending on the age of the university spin-off in the year 2011. It can clearly be seen, that with advancing age the number of employees working in each university spin-off rises. It is nevertheless remarkable, that the majority of university spin-offs stay small even after many years on the market. In my sample the share of micro and small

enterprises adds up to almost 90%. The other university spin-offs belong to the category of medium enterprises. Only one university spin-off has the chance to become a large enterprise in the near future. Noticeable is the fact, that in the last twelve years not a single university spin-off of my sample has developed to a medium enterprise at least.

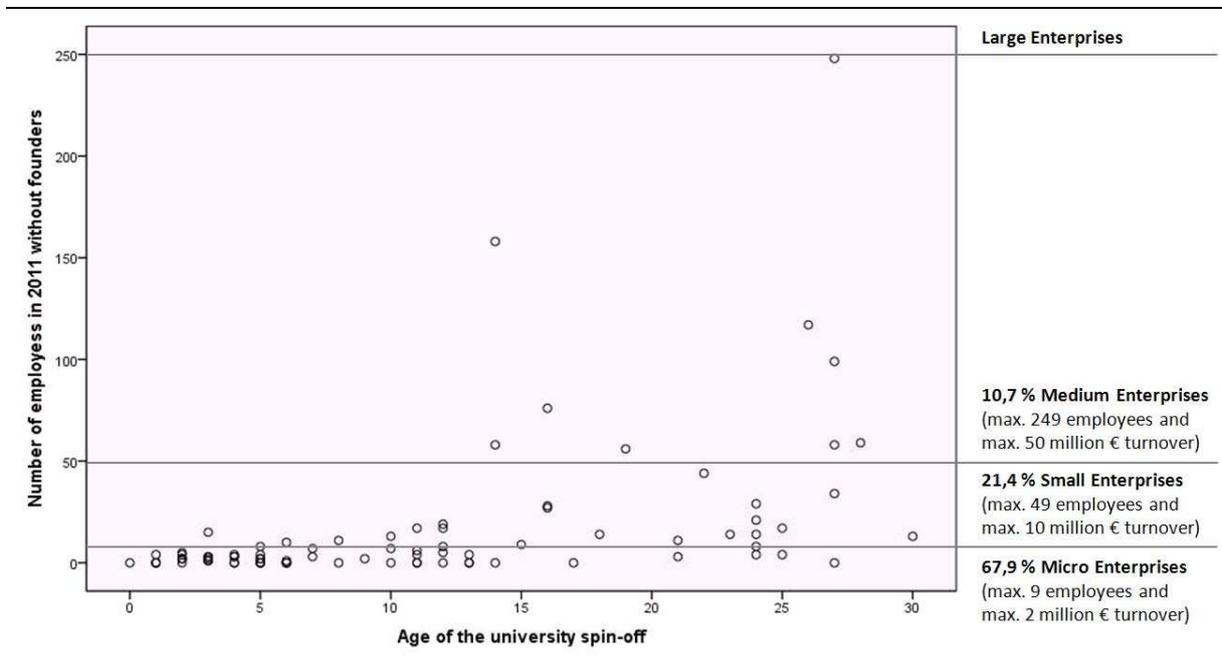


Figure 2: Increase in the Number of Employees Depending on University Spin-off's Age in 2011.

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.

This result raises the question why most of the university spin-offs in my sample stay small. In this chapter I show career paths of successful and less successful university spin-offs in order to show how these career paths and the level of knowledge transfer influence university spin-off growth in terms of job creation (research question 2).

Figure 3 shows academic entrepreneurs' career paths of high and low growth university spin-offs. It is immediately noticeable how academic entrepreneurs' career paths can vary considerably. The relation between the academic career level, character of knowledge transfer and university spin-off growth is not clearly recognizable. Here, the qualitative approach has a big advantage and makes it possible to analyze the academic career paths in more detail. In the following paragraphs I show how different academic career paths before and after university spin-off formation can affect university spin-off growth.

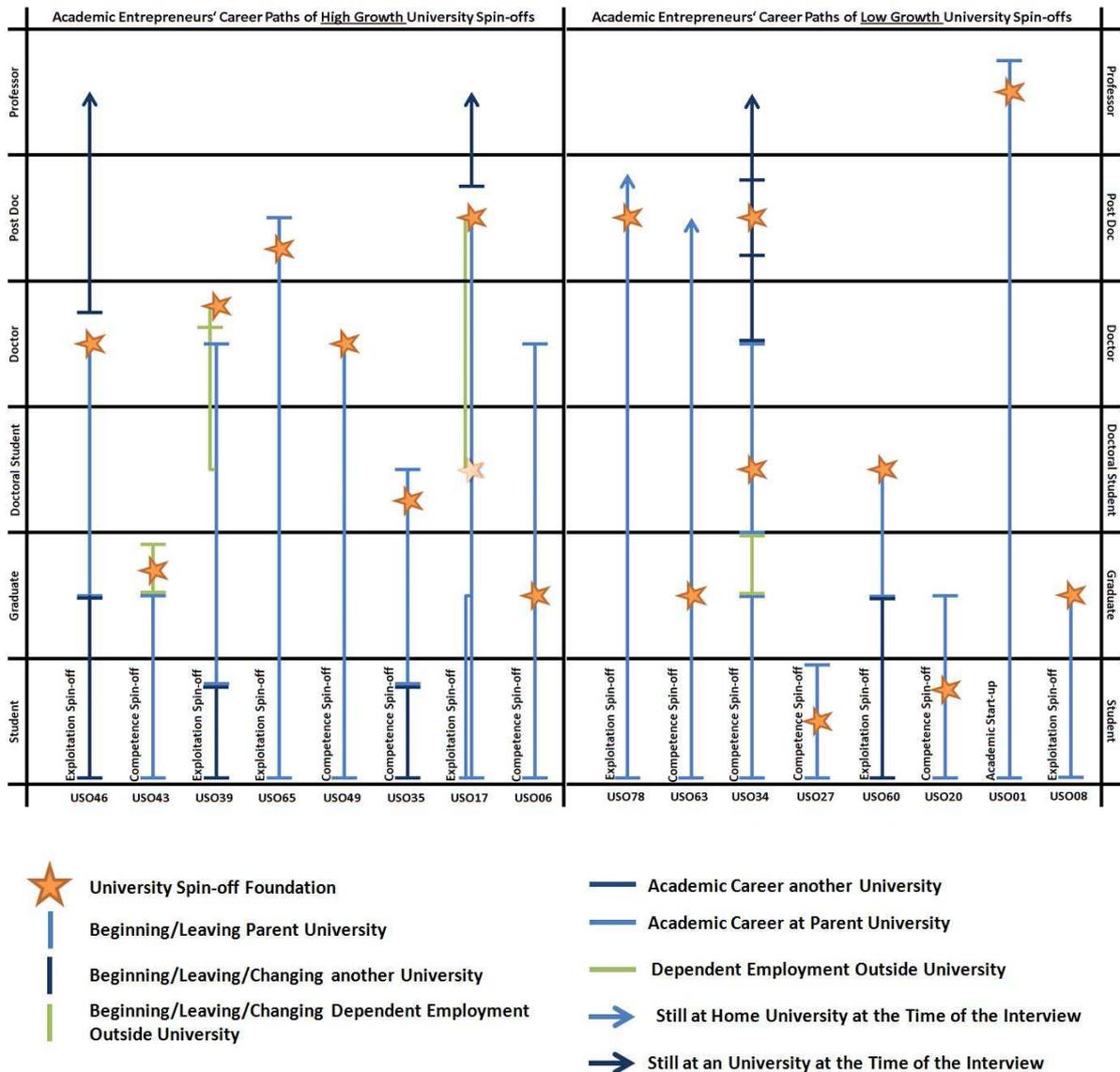


Figure 3: Academic Career Paths of High Growth and Low Growth University Spin-off Founders.

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. Average annual increase in employees of high growth university spin-offs ranges from 3,67 to 11,29 and of low growth university spin-offs from 0,00 to 0,16.

6.1 Students and Graduates

About one half of the students in my sample implemented their ideas already in parallel to their studies and one half during or right after graduation. Apart from these rather typical career paths, there are several other paths which took place. There are a few students who broke up their studies in order to work full-time in their newly established university spin-off. Longer transitional periods, sooner or later, lead to the decision between continuation of business or studies. There are also some graduates who actually wanted to be dependently employed but after a short period of time they realized that this kind of employment is not completely what they expected. Others decided to

continue their academic career and work in the university spin-off at the same time on a part-time basis. For one part of these persons the academic career serves solely to finance themselves in the first years of enterprise, but this career path can also be chosen because of opposite motives. For the other part of these persons, an academic career is the first choice. They never plan to be a full-time entrepreneur and leave university. They rather want to be a doctoral student and view the university spin-off as an attractive possibility to finance their subsequent academic career, as this post doc reports: *“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). He founded a university spin-off right after his graduation and continued his academic career (see also [figure 3](#)). Obviously, the university spin-off is a means to an end for him. A university spin-off founded with this reasons will hardly become a big company.

At this early stage in the career starting a university spin-off has low entry barriers. In most cases, students and graduates 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 (see also [figure 3](#)): *“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. They are able to adapt to new situations quickly. They have to take very little responsibility in terms of family or employment and therefore they are able to realize their freedom. At that young age, people are also more willing to learn something new.

The flip side of this coin is that students and graduates possess only little expert knowledge, industry knowledge and life experience, 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). However, this is not the only thing which young entrepreneurs have to struggle with. Due to their little working experience students and graduates have only little experience in project management. The little experiences, which they have, are mostly only 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. In addition, some students and even graduates had to cope with legitimacy problems in the first years, as the same student later also 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 researchers normally do not have to cope with such prejudices, as explained in the following passages.

6.2 Doctoral Students, Research Associates and Doctors

Two thirds of the doctoral students in my sample implemented their ideas already in parallel to their studies and one third after finishing the doctorate. Some doctors want to continue their academic career and work in the university spin-off at the same time on a part-time basis. For some of them the academic career serves solely to finance themselves in the first years of enterprise. Others have chosen this career path because they understand the university spin-off as an attractive option to finance their subsequent academic career or to gain reputation as university professor later. They never plan to be a full-time entrepreneur because they rather want to do research and teaching.

There are also doctors who actually wanted to be dependently employed after finishing their doctorate but after a short period of time they realized that they are not satisfied with this kind of employment. In the years in university they got used to the unrestricted and independent kind of working. Nevertheless, a short dependent employment in the private sector is far from being useless. The founders, who took this path, underline that they got a good on-the-job training especially in small companies, gained important insights in the respective sector and could extend their social network through important key contacts. In addition, in the short time as a dependent employee in the private sector doctors also have the opportunity to build up sufficient savings for the realization of a university spin-off.

One third of the doctoral students in my sample, who established a university spin-off during their doctoral studies, decided to break up their theses. Especially if the doctoral degree is only a minor detail for the university spin-off success and the entrepreneurial work is more interesting for them. *“I started my doctoral studies and broke up because I found the topic quite fruitless and at the same time the firm gathered momentum more and more. At some point I said, the own company is much more fun than counting bristles on worms.” (USO13)*. In contrast, the doctoral students, who continued their theses, tend to see their university spin-offs more as a part-time job and not with the purpose of establishing a bigger company. Nevertheless, it should be considered that the holding of a doctoral degree of course bears also 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, as this interviewee reports (see also [figure 3](#)): *„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).

In Germany doctoral students often only have part-time contracts. They are quite flexible because they can plan the rest of their time relatively freely. 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 my sample did.

In Germany, doctors normally can earn high wages, especially in occupations with skill shortages like in engineering. This of course raises the doctor’s opportunity costs of founding a university spin-off. A few doctoral students, who founded a university spin-off during doctoral studies, realized after finishing the doctorate that they can earn much higher wages as dependent employee in the private sector while they also have a regular income with a higher social security and a lower workload at the same time. In my sample there were a few newly graduated doctors who left the founding team of the university spin-off at this moment. This loss of knowledge of course caused severe trouble for the remaining team.

6.3 Post Docs and Professors

Post docs plan to stay in university after finishing their doctorate in order to continue their academic career. Nevertheless the post docs in my sample decided to startup a university spin-off at a certain point of time. The reason for this decision can partly be found in the lack of job security in university due to part-time and fixed-term contracts. Usually post docs have 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, many post docs manage to go on two-tracked regarding their occupational activities. Many of these kinds of academic entrepreneurs stay in university in the long term. This kind of university spin-offs usually stays small. In contrast, the post docs who leave university immediately after foundation or after a transitional period, have a good chance to establish big companies (see also [figure 3](#)).

Beside this, there are also post docs 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, these kinds of university spin-offs have a high growth potential because they are highly innovative and the post doc has a high commitment. However, a long development phase due to a low market maturity

of the developed products or a service oftentimes result in high financing needs and delays the growth.

Usually, for professors the scientific career is at the first place and the university spin-off is rather an attractive 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 this way as well as research and teaching. Therefore, most professors do not start a university spin-off with full commitment. In my sample I did not have any professor who leads his university spin-off full-time. 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). My 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 3](#)).

Post docs and professors usually possess a high reputation which makes it easier 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. Especially at advanced age it is also difficult to get used to the stress and workload that managing a university spin-off entails, as the same professor further reports: *"Besides that, to this day 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).

Many post docs and professors reached an age when they are oftentimes responsible for a family. At the same time, they have high opportunity costs. Therefore, they think twice before founding a university spin-off. To become self-employed is not an easy step to take for them and is often coupled with fears, as this post doc refers: *"I just got married and my wife was pregnant. I was also 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). This quotation also implies that post docs and professors have a reputation to lose. They even risk their further academic career if they found a university spin-off with full commitment and it fails. In this case the decision to leave university was not quite voluntarily but it worked out very well. The post doc did not only establish a big service company in a few years but also returned to university after some years to continue his university career and finish his habilitation. At the time of the interview he was already a professor (see also [figure 3](#)).

Due to different value systems between academia and the private sector several other challenges emerge. People who stay in university and plan to become a professor one day are usually not very business oriented. They are rather driven by a scientific interest. A professor must grow into an entirely new role at a quite advanced age. This makes it difficult for them to run a university spin-off at the beginning. 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).

In this chapter I show how different career paths and the level of knowledge transfer influence university spin-off growth. The results show that the career paths before and particularly after the start of the company can crucially influence subsequent growth. In this respect, a full commitment of at least one founder of the team is oftentimes more important than the level of knowledge transfer.

7 Limitations

Qualitative research generally focuses on analytical generalization. Therefore, it bears some limitations concerning wider implications. Although this study involves a relatively large sample and my approach of investigating German mid-range universities is a particularly suitable example for displaying the German reality, the results are only to a limited extent transferable to other regions or countries. My conclusion is solely based on a sample within the German context and both universities are located in the same federal state with comparable locational environments.

My study is largely based on established university spin-offs. This common approach, however, leads to some limitations, that need to be taken into account. I knowingly contacted only 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 a university spin-off. This implies a selection bias. Also, academic entrepreneurs, who responded to my contact request, may be more successful than those who did not want to be interviewed. Furthermore, I only took private limited companies and corporations into account. Thus, there is a general success bias. Like many other studies, I have 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.

In this study, success is defined as company's growth and size. I used job creation as central criteria. Nonetheless, it should be noted that success is quite relative and different definitions of success exist (see HAYTER 2010:340). Success always depends on the respective business goals. Other interpretations of business success may therefore lead to different results. The results of this study are therefore only valid for my definition of success. Also, the understanding of success is not static and may change during the business development process.

8 Conclusion

University spin-offs are oftentimes seen as highly innovative and fast growing companies, not least because of the academic entrepreneur's human capital and the character of knowledge transfer. Of course, academic entrepreneur's human capital is an important factor for a successful university spin-off. Also, my data shows that with advancing time in university, the expert knowledge increases. The character of knowledge transfer therefore changes from basic competencies at the student level, which is considered as less innovative, to transferring research results into practice at the level of doctors and above, which is considered as highly innovative. Many studies equate the level of

innovativeness with the growth of the university spin-off (see for example BATHOLT/KOGLER/MUNRO 2010). This cannot be confirmed by the results of this study.

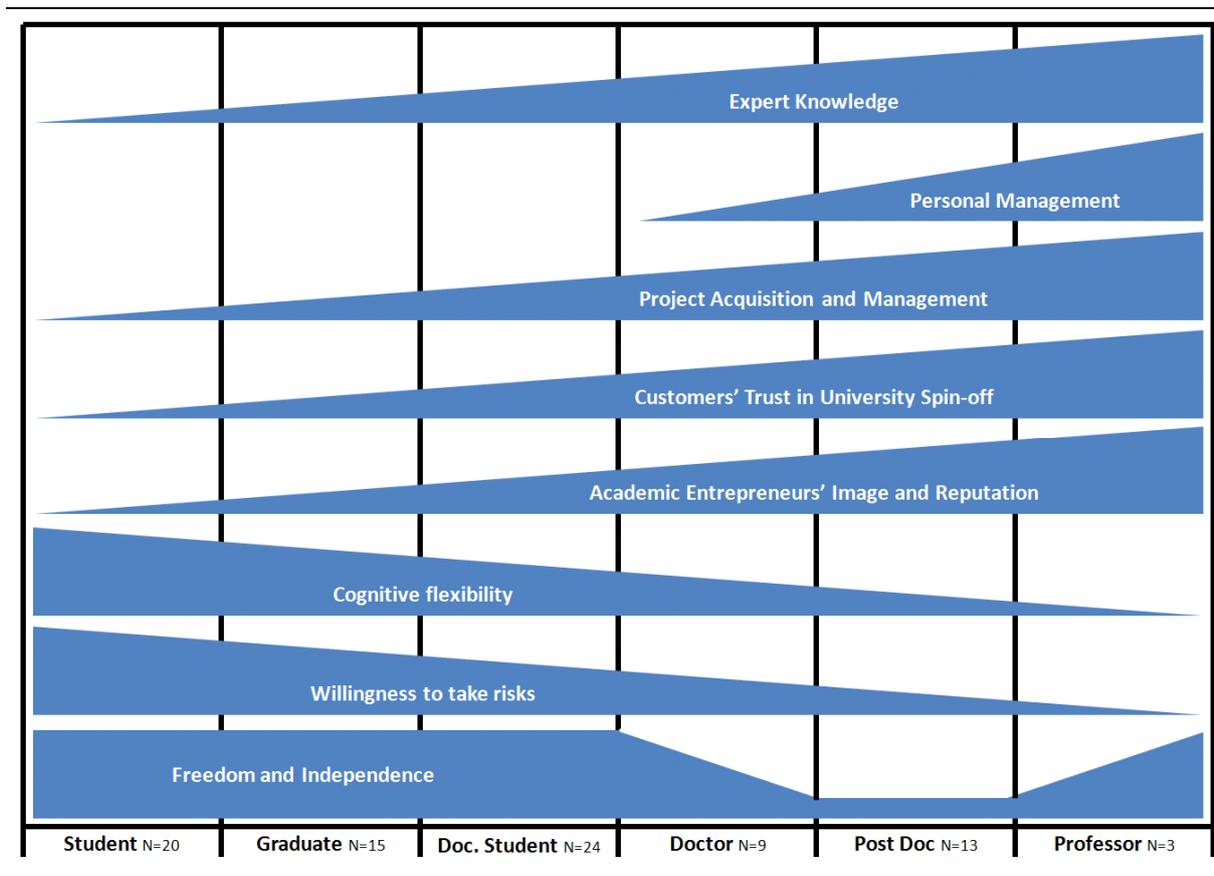


Figure 4: Expert Knowledge, Competencies and Challenges of Academic Entrepreneurs of different Career Levels.

Source: Own illustration and survey 2011.

Note: Only advantageous skills and characteristics are displayed. The missing of these advantages may be counted as disadvantages, but beware that each advantage may also entail a respective disadvantage as explained in the text.

In contrast, the empirical findings show that the character of knowledge transfer was not crucial for university spin-off growth, because the often cited “gazelles” rather belong to the minority of university spin-offs in Germany. The vast majority of the university spin-offs in my sample stayed small. By comparing extreme positive and negative cases it becomes obvious that the character of knowledge transfer which is based on the human capital acquired in university is not the decisive factor. My empirical results support the hypothesis of a trade-off between scientific expertise and entrepreneurial qualification. Therefore, every academic career level has certain potentials and challenges to cope with like summarized in [figure 4](#).

Human capital and the character of knowledge transfer are not crucial for university spin-off growth because they are related to the academic entrepreneur’s career path which includes several other factors. Instead, the career path after the university spin-off foundation seems to be very important. Around one third of the academic entrepreneurs in my sample decided to continue their academic 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.

This paper contributes to a better understanding of the factors which influence university spin-off growth and in a second step to better support university spin-offs headed by founders with different ideas on how to continue their career and university spin-off growth. On the basis of my results, my policy recommendation is to bring together different types of founders with complementary skills (see BREITENECKER/SCHWARZ/CLAUSSEN 2011) and career paths ideas. Young 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 expert knowledge of the professor 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 hierarchy levels 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 my empirical study I have 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.

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