

Academic Entrepreneurs: Attitudes, Careers and Growth Intentions

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Abstract

Academic entrepreneurship is regarded to be a direct channel of knowledge and technology transfer from university to industry. Companies started by academic entrepreneurs are deemed to positively influence the regional economy. Despite this relevance, only a few studies have paid much attention to the persons who are directly involved in these processes. Academic entrepreneurs have different attitudes. They start up businesses at different stages in their university careers and have different growth intentions. This in turn has effects on the development and the performance of the university spin-offs. In order to better understand these complex relations, this dissertation addresses academic entrepreneurs by applying a combination of different research perspectives and designs.

The core of this dissertation consists of three separate studies which address the following aims: (1) to compare the entrepreneurial potential of prospective scientists to prospective entrepreneurs. This study investigates the relationship between the intention of students to become scientists or entrepreneurs and their attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare. (2) To investigate how the career paths of academic entrepreneurs influences university spin-off growth with regard to the perspectives of human capital, university status and role identity. (3) To investigate why the majority of university spin-offs remain small. This study considers the growth ability of the university spin-off and the growth willingness of the academic entrepreneur with regard to the different stages in the university spin-offs' growth paths.

The data used in this dissertation was collected in the context of a research project named "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen" in collaboration with the Global University Entrepreneurial Spirit Students' Survey. In these projects, two major databases were generated. One is based on an extensive qualitative survey of 87 academic entrepreneurs; the other one is based on a standardized online survey of 3151 students. Major methodological tools used in the analyses are multivariate analytical statistics, qualitative content analyses and a qualitative generation of types.

Overall, this dissertation contributes to understanding the heterogeneity of academic entrepreneurs and their university spin-offs while also underlining certain recurring patterns and problems in the interaction between the academic entrepreneur, the university spin-off and the university itself that are very characteristic to the phenomenon of academic entrepreneurship.

Key words: academic entrepreneur, university spin-off growth, career attitude, career path, growth intention

Kurzzusammenfassung

Unternehmensgründungen aus Hochschulen sind ein direkter Kanal des Wissens- und Technologietransfers von Hochschulen in die Wirtschaft und können die regionale Wirtschaft positiv beeinflussen. Trotz dieser Bedeutung wird den Personen, die hinter diesen Prozessen stehen, bisher relativ wenig Beachtung geschenkt. Akademische Gründer sind heterogen, sie haben unterschiedliche Einstellungen, gründen Unternehmen zu unterschiedlichen Zeitpunkten in ihren akademischen Karrieren und mit verschiedenen Vorsätzen hinsichtlich des Unternehmenswachstums. Dies wiederum hat Einfluss auf die Entwicklung der Unternehmen. Um diese komplexen Zusammenhänge besser zu verstehen werden in dieser Dissertation akademische Gründer mithilfe verschiedener Forschungsperspektiven und Forschungsdesigns untersucht.

Den Kern der Arbeit bilden drei eigenständige Studien, die folgende Ziele verfolgen: Das erste Ziel ist herauszufinden, wie unternehmerisch angehende Wissenschaftler im Vergleich zu angehenden Unternehmern sind. Diese Studie untersucht die Beziehung zwischen den wissenschaftlichen bzw. unternehmerischen Karriereplänen von Studierenden und ihren Einstellungen bezüglich Selbstverwirklichung, Anerkennung, Unabhängigkeit, Innovation, Rollenvorbildern, finanziellem Erfolg und gesellschaftlicher Wohlfahrt. Das zweite Ziel der Arbeit ist zu untersuchen, wie die universitären Karrierepfade, unter besonderer Berücksichtigung des Humankapitals, des universitären Status und der Rollenidentität der Gründer, das Wachstum ihrer universitären Ausgründungen beeinflussen. Das dritte Ziel ist es herauszufinden, warum die Mehrheit der universitären Ausgründungen klein bleibt. Dabei werden sowohl die Wachstumsfähigkeit der Unternehmen als auch der Wachstumswille der Gründer berücksichtigt und mit den spezifischen Wachstumspfaden der Ausgründungen in Beziehung gesetzt.

Die in dieser Dissertation verwendeten Daten wurden im Rahmen des Forschungsprojekts „Universitäre Spin-Off Gründungen in Niedersachsen und ihre regionalwirtschaftlichen Wirkungen: die Beispiele Hannover und Göttingen“ und in Zusammenarbeit mit der „Global University Entrepreneurial Spirit Students’ Survey“ erhoben. Die Forschungsprojekte beruhen auf zwei unterschiedlichen Datensätzen, von denen einer auf einer weitreichenden qualitativen Befragung von 87 akademischen Gründern beruht und der andere auf einer standardisierten Onlinebefragung von 3151 Studierenden. Die Analysen basieren unter anderem auf multivariaten statistischen Berechnungen, qualitativen Inhaltsanalysen und einer qualitativen Typenbildung.

Insgesamt trägt diese Dissertation dazu bei, die Verschiedenartigkeit der akademischen Gründer und ihrer universitären Spin-offs zu verstehen, wobei gleichzeitig auch wiederkehrende Muster und Probleme im Zusammenspiel von akademischen Gründern, universitären Spin-offs und der Universität herausgestellt werden, die sehr charakteristisch für das Phänomen von Unternehmensgründungen aus Hochschulen sind.

Schlagworte: Akademische Gründer, Wachstum universitärer Ausgründungen, KarriereEinstellung, Karrierepfad, Wachstumseinstellung

Dedicated to my father whom I miss very much.

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Writing a dissertation is a bit like founding a business: You create something new which you have to justify towards others, you have to overcome obstacles again and again and you invest a lot of work and time without seeing any success for a long time. All this is only possible with the support from colleagues, family and friends.

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¹ Please note that at the end of each chapter another small paragraph of specific acknowledgements exists. In case I have still missed to acknowledge anyone, I apologize and assure that this is purely accidental.

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Abbreviations

BLR	Binary logistic regression
eds.	Editors
e.g.	exempli gratia (for example)
et al.	et alii (and others)
GAUG	Georg-August-Universität Göttingen
GUESSS	Global University Entrepreneurial Spirit Students' Survey
key inf.	Key informant
LUH	Leibniz Universität Hannover
MINT	Mathematics, informatics, natural sciences and technology
MLR	Multinomial logistic regression
USO	Research project "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen"

1 Introduction

Traditionally, universities have two main missions: teaching and research. However, during the past decades, higher education is increasingly facing new challenges, for example the rapid development of information and communication technology, the growing importance of the knowledge economy, severe economic disturbances and consequently varying funding conditions. As a consequence, higher education continuously needs to reconsider its role in society and economy (ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT/EUROPEAN COMMISSION 2012). One concept to meet these new challenges is attributed to the universities' new "third mission" (ETZKOWITZ/LEYDESDORFF 1997, 2000). This approach assigns universities an increasingly important role in regional innovation, economic development and social change in addition to their two traditional missions of teaching and research (ETZKOWITZ/LEYDESDORFF 2000; LAWTON SMITH 2003, 2007). If universities pursue all three missions they become "entrepreneurial universities" (ETZKOWITZ 2008). In the past, some high-tech regions have developed on the basis of such universities with a "third mission". Famous examples are Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina. A key mechanism that has helped these regions to develop was the effective transfer and application of knowledge from the university to the surrounding regional economy (SAXENIAN 1983; STERNBERG 2010).

One important direct channel of knowledge transfer and commercialization from university to industry is regarded to be academic entrepreneurship. The term academic entrepreneurship describes the phenomenon that students and scientists become entrepreneurs based on their research knowledge and inventions. They develop new products or services and startup companies. Consequently, these persons are then referred to as academic entrepreneurs and the established companies as university spin-offs.²

The main assumption in the literature on university spin-offs is that they are more innovative, grow faster and have a higher survival rate than other start-up companies because they benefit from the technology transfer from university (CZARNITZKI/RAMMER/TOOLE 2014; EGELN et

² It should be noted that a general terminology or definition of academic entrepreneurship, academic entrepreneurs or university spin-offs does not exist. The terms "university spin-offs", "academic spin-offs" and "university start-ups" are often used synonymously in the literature. The same is true for the term "academic entrepreneur" which is also referred to as "university spin-off founder" or "entrepreneurial scientist". For an overview on the existing definitions see PIRNAY et al. (2003). Detailed information on the working definitions of academic entrepreneurs and university spin-offs used in this dissertation are given in the respective chapters.

al. 2002; LAWTON SMITH/HO 2006; ZHANG 2009). This in turn is beneficial for the regional development and is therefore of key interest for policy makers.

For these reasons, the issue of the entrepreneurial university and academic entrepreneurship has now also been widely acknowledged in Germany. Since the reform of the so-called university teachers' privilege (Hochschullehrerprivileg) in 2002, German research institutions are allowed to make commercial use of its staffs' inventions, whereby the inventor gets a 30 % share of the revenues. This is comparable with the Bayh-Dole Act in the USA which was already implemented in 1980 (GRIMM 2011). Since the 1990s, entrepreneurial support programs, entrepreneurship professorships and technology transfer offices have been created in Germany. Several studies regularly give overviews on the entrepreneurial situation at German universities (BERGMANN/CESINGER/OSTERTAG 2012; SCHMUDE/AEVERMANN/HEUMANN 2011) and evaluate the entrepreneurial support programs at a national (KULICKE/DORNBUSCH/SCHLEINKOFER 2011) and regional level (STERNBERG 2014). However, these studies also reveal that despite recent improvements, much remains to be done to encourage academic entrepreneurship, and there are still substantial differences in entrepreneurial conditions across universities.

In contrast to a wide range of literature on top universities and regions like Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (SAXENIAN 1983; STERNBERG 2010), this dissertation looks at cases from the two biggest universities in Lower Saxony, Germany with regard to the total number of students³, the number of students in subjects which are common for university spin-offs⁴, the number of scientific staff, and research expenditures (KULICKE et al. 2008). The two chosen universities, Hannover and Göttingen, are particularly suitable examples for German universities with a rather weak entrepreneurial culture and support structure located in regions without notable high-tech clusters (BERGMANN/CESINGER/OSTERTAG 2012; SCHMUDE/AEVERMANN/HEUMANN 2011).

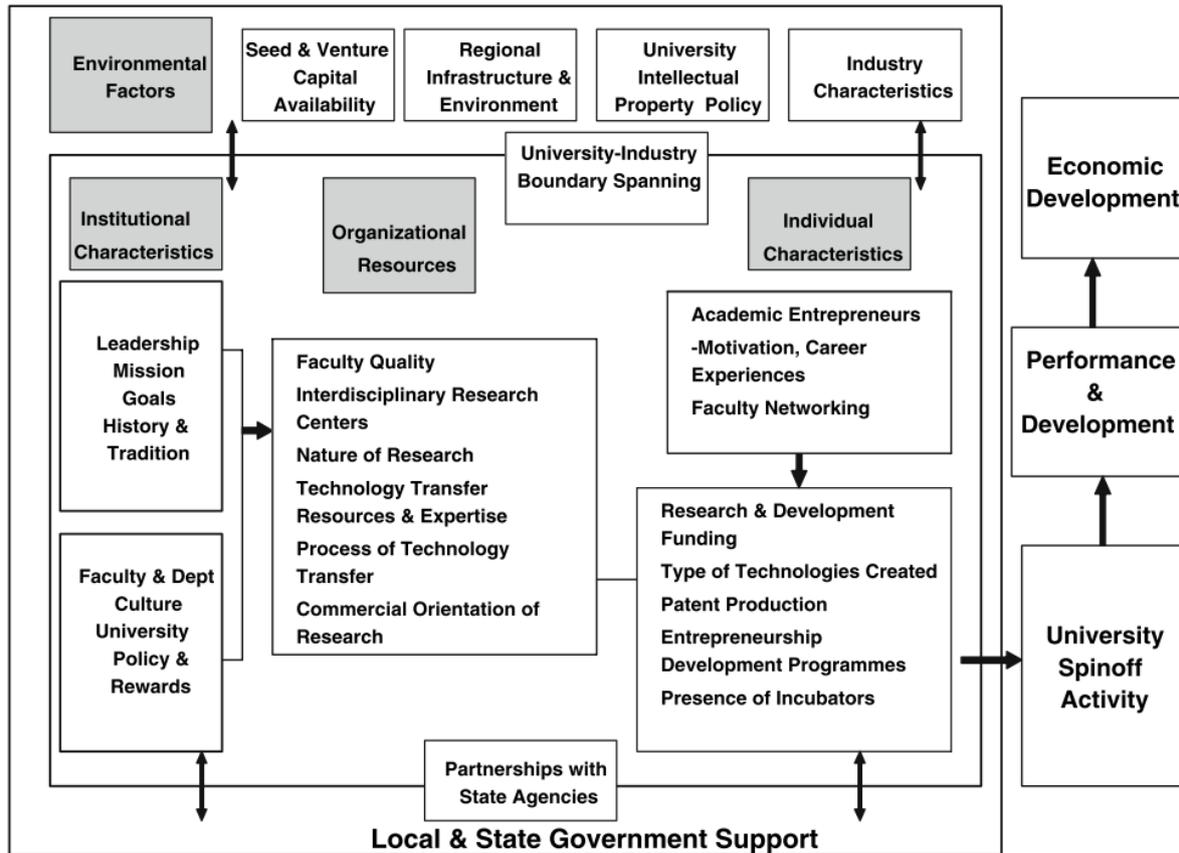
³ The Leibniz Universität Hannover had 21478 students and the Georg-August-Universität Göttingen 26381 students in the summer semester 2013 (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2013b; LEIBNIZ UNIVERSITÄT HANNOVER 2013b).

⁴ These are the MINT subjects (mathematics, computer science, natural science and engineering) and medical science (KULICKE et al. 2008). MINT subjects are comparable to the STEM fields used in English. These include science, technology, engineering and mathematics.

1.1 Previous Literature and Research Gaps

While the political interest on academic entrepreneurship has increased during the past years, research on this topic has also gained in importance since the 1980s. Meanwhile, it has even become quite extensive (ROTHAERMEL/AGUNG/JIANG 2007). Nowadays, a large variety of scholars with different academic backgrounds, including business and economics, sociology, psychology, pedagogy or economic geography, deal with the topic of academic entrepreneurship. A few studies provide a review on the literature of university spin-offs (DJOKOVIC/SOUITARIS 2008; O'SHEA/CHUGH/ALLEN 2008; ROTHAERMEL/AGUNG/JIANG 2007). O'SHEA, CHUGH and ALLEN (2008) identify six separate streams in the existing literature and summarize their results in a comprehensive framework (see Figure 1). While the first four streams of literature focus on the determinants for university spin-off activity, the last two address the outcome of university spin-offs. The different streams and exemplary studies are briefly listed in the following.

1. Individual abilities and dispositions and their impact on the entrepreneurial behavior of academics (see Chapter 1.1.1 for examples).
2. Organizational and human resource aspects of the university, such as the level and nature of research funding (LOCKETT/WRIGHT 2005), the quality of the researchers (ZUCKER/DARBY/BREWER 1998), the nature of the research within the university (O'SHEA et al. 2005), the presence of technology incubators and technology transfer offices (DEGROOF/ROBERTS 2004), and their significance for university spin-off activity.
3. University spin-off activity as an reflection of institutional behavior, especially of the university culture towards commercialization of research results (STUART/DING 2006).
4. External determinants like venture capital (WRIGHT/VOHORA/LOCKETT 2004), the legal assignment of inventions (BALDINI 2009), the knowledge infrastructure and industry structure in the region (FELDMAN/DESROCHERS 2003) and their impact on university spin-off activity.
5. The development and performance of university spin-offs (see Chapter 1.1.2 for examples).
6. The impact of university spin-offs on regional economic development (SHANE 2004).



Source: O'SHEA, CHUGH and ALLEN (2008:11)

Figure 1: University Spin-off Framework

DJOKOVIC and SOUTARIS (2008) provide another literature review on university spin-offs. They broadly differentiate studies on the macro-, meso- and micro-level. The macro-level studies deal with the governmental and industrial support mechanisms in the university spin-off process as well as the technology and market factors that are beneficial to university spin-off creation. Studies on the meso-level address tangible university support mechanisms like incubators and technology transfer offices as well as intangible university based determinants of spinout activity like the entrepreneurial culture. Furthermore, studies on the meso-level deal with the effectiveness of spin-offs as technology transfer mechanism from universities compared to other mechanisms such as licensing, meetings, publications, cooperative research and development agreements. On the micro-level, the studies include the role of founders and the founding team during the university spin-off formation process, the networks with university and industry and the resulting performance of university spin-offs.

The contributions of this dissertation can be allocated to the micro-level. In addition, I contribute to the first and fifth area of research within the framework by O'SHEA, CHUGH and ALLEN (2008), namely the role of the academic entrepreneur and the development and

performance of the university spin-offs. For these reasons, these two streams of literature and the remaining research gaps are briefly introduced in the following two subchapters.

1.1.1 The Academic Entrepreneur

Studies on the academic entrepreneur usually deal with the “*personality, ability, career choice, or willingness of the individual to engage successfully in entrepreneurial behavior.*” (O’SHEA/CHUGH/ALLEN 2008:656). This means that university spin-off behavior is understood as a reflection of individual actions. Thereby, some empirical studies use models like “The Theory of Planned Behavior” (AJZEN 1991) or “The Entrepreneurial Event Model” (SHAPERO/SOKOL 1982) in order to investigate the evolution of entrepreneurial intentions (e.g. GÖTHNER et al. 2012; GUERRERO/RIALP/URBANO 2008; KRUEGER/REILLY/CARSRUD 2000; ZELLWEGER/SIEGER/HALTER 2011). Some recent empirical studies that refer to AJZEN (1991) suggest that entrepreneurial growth intentions are important for subsequent business growth (CASSAR 2007; DOUGLAS 2013; GUNDRY/WELSCH 2001; HERMANS et al. 2012; STAM et al. 2007; VAN STEL et al. 2010). However, this issue has hardly been considered in the field of academic entrepreneurship yet.

Furthermore, some scholars in this stream of research investigate the influence of the academic entrepreneur’s education, experience and social networks on the formation and success of university spin-offs (e.g. MOSEY/WRIGHT 2007; MÜLLER 2006). The approaches used in these studies are typically based on the human capital theory (BECKER 1975), on the idea of strong and weak ties (GRANOVETTER 1973) or on bridging and bonding capital (PUTNAM 2000), to name just three.

Although the academic entrepreneur is of central importance for university spin-off creation and development, as university spin-offs are largely based on the academic entrepreneur’s tacit knowledge and growth intention, research with a special focus on the academic entrepreneur is still in a relatively early stage (ROTHAERMEL/AGUNG/JIANG 2007). It may be tempting to simply transfer the findings from studies on conventional entrepreneurship to the field of academic entrepreneurship. However, this does not meet the issues of this specific phenomenon because the transition from academia to entrepreneurship entails particular challenges (ALDRIDGE/AUDRETSCH 2011; FINI/LACETERA 2010). For example, the academic entrepreneur has to face the trade-off between a scientific career and an entrepreneurial activity (NICOLAOU/BIRLEY 2003). Furthermore the non-commercial university environment shapes the academic entrepreneurs for years before they found a university spin-off and have

to compete on the market with highly innovative products (ALDRIDGE/AUDRETSCH 2011; FINI/LACETERA 2010; SHANE 2004).

Consequently, the investigation of a scientist's transition to being an entrepreneur is especially crucial to better understand the phenomenon of academic entrepreneurship. In this regard, scholars particularly express the need for more research. A particularly important research gap in this regard is the identification of different types of university spin-offs and at different stages in connection with the academic entrepreneurs and their relationships to the university (NICOLAOU/BIRLEY 2003).

1.1.2 University Spin-off Development and Performance

The development and performance of university spin-offs have been neglected for a long time in the literature, probably because the phenomenon has appeared rather recently. Meanwhile, a small but increasing number of studies has addressed this topic (DJOKOVIC/SOUITARIS 2008; O'SHEA/CHUGH/ALLEN 2008).

Some scholars view academic entrepreneurship from the procedural perspective and have identified different phases of university spin-off development that build on one another (DEGROOF/ROBERTS 2004; DRUILHE/GARNSEY 2004; NDONZUAU/PIRNAY/SURLEMONT 2002; ROBERTS/MALONE 1996; VOHORA/WRIGHT/LOCKETT 2004). VOHORA, WRIGHT and LOCKETT (2004) for example recognized five phases: research, opportunity framing, pre-organization, re-orientation and sustainable returns. In order to pass from one phase to the next, the university spin-off has to overcome four critical junctures: an opportunity recognition, an entrepreneurial commitment, a threshold of credibility and a threshold of sustainability.

Empirical evidence on the performance of university spin-offs is still inconclusive (HELM/MAURONER 2007). While many studies come to the conclusion that university spin-offs are more innovative, grow faster and have a higher survival rate than other start-up companies (CZARNITZKI/RAMMER/TOOLE 2014; EGELN et al. 2002; LAWTON SMITH/HO 2006; ZHANG 2009), an increasing number of empirical studies claim that many university spin-offs remain small (ENSLEY/HMIELESKI 2005; NIGHTINGALE/COAD 2011). Especially at mid-range universities located far from high-tech clusters, university spin-offs seem to have only minimal levels of job creation (DEGROOF/ROBERTS 2004; HARMON et al. 1997; HEMER et al. 2006).

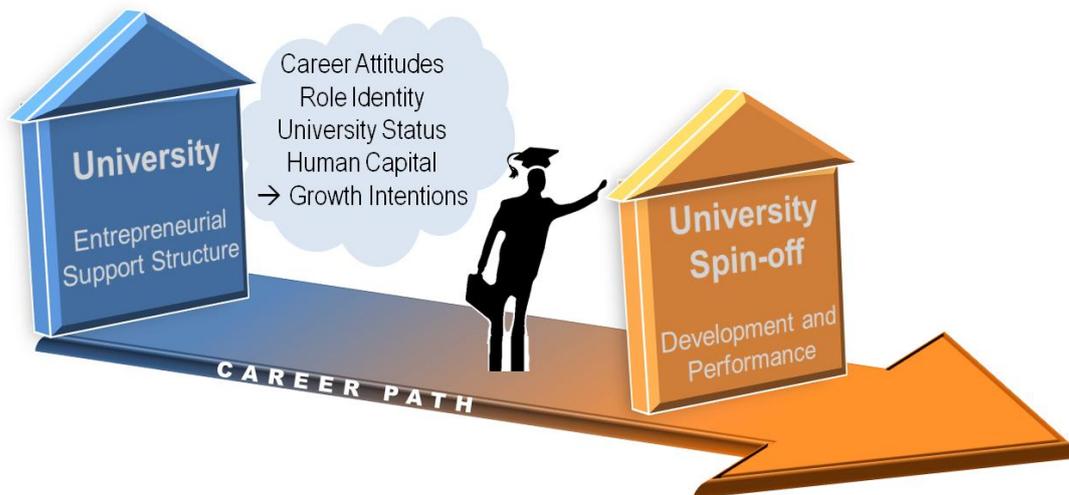
Overall, most studies in this field focus on the short-term development and performance of university spin-offs so that a lot more remains to be explored regarding their long-term

development and performance. ALDRIDGE and AUDRETSCH (2011) as well as DJOKOVIC and SOUTARIS (2008) claim that future research should more deeply investigate the post-startup performance of university spin-offs. DJOKOVIC and SOUTARIS (2008) also articulate a need in further research regarding university spin-off life cycles and its specificities in order to legitimize the research on university spin-offs as a phenomenon of its own.

University spin-off development is quite complex, as it is path dependent and must continuously adapt to a changing environment. Therefore the existing mainly quantitative studies are not sufficient to fully explain university spin-off development. Furthermore, the many mainly economically dominated studies in this field do not consider that the academic entrepreneur can freely choose to bring the university spin-off forward or not. Qualitative studies may provide a deeper understanding on the very individual and social mechanisms at work and can thus complement existing studies.

1.2 Objectives and Structure of this Dissertation

This dissertation is a compilation of papers that aim at filling the research gaps mentioned above by further investigating the academic entrepreneurs and the growth of their university spin-offs. I pay particular attention to the links between university, academic entrepreneur and university spin-off development and performance. Thereby, academic entrepreneurship is understood as a continuous process and the act of university spin-off creation is understood as being part of an individual's career path. Which career path an individual decides to pursue is influenced by his/her career attitudes. A major element that determines the career paths of academic entrepreneurs is the time spent at a university. The university career affects the academic entrepreneur's human capital, role identity, university status, and resulting entrepreneurial growth intention. Figure 2 outlines these thematic priorities. The partly qualitative research approach focuses on the individual but does not neglect the institutional, organizational and partly environmental context, of which the individual is aware and in which he or she is embedded. In this context, it should be noted that one central condition for the investigations in this dissertation is that the academic entrepreneur is involved in the newly formed university spin-off, no matter if he or she remains affiliated to the university.



Note: The purpose of this figure is to demonstrate the thematic priorities of this dissertation and should not be understood as the conceptual framework because the dissertation consists of several research papers that each contain their own conceptual framework.

Source: Own illustration

Figure 2: Thematic Priorities of the Dissertation

This introduction is followed by a chapter that outlines the entrepreneurial environment at the two chosen universities Hannover and Göttingen. The following three chapters form the core of this dissertation. Each chapter is an independent research article and has an individual focus. The objectives of this dissertation are first to investigate the entrepreneurial disposition of prospective scientists in regards to their career attitudes by comparing them to prospective entrepreneurs. The second aim is to investigate how the university career paths of academic entrepreneurs affect university spin-off growth. The third objective is to figure out why many university spin-offs remain small. Earlier versions of these research articles have been presented on national or international conferences and workshops⁵. These articles are also to be published in reference books or peer-reviewed journals. Due to the independent nature of these chapters, they can be read separately from each other. Therefore, when reading the chapters in the chronological order, repetitions occur with regards to background information and data descriptions. Finally, an overall conclusion including implications for policy and future research is drawn.

⁵ These conferences and workshops include the 17th Uddevalla Symposium in Uddevalla in June 2014, Workshop “Universitäre Spin-off Gründungen und ihre Förderung“ in Hannover in February 2014, the 17th Forum Entrepreneurship Research (G-Forum) in Koblenz in November 2013, the “Abend für Gründer und Unternehmer aus der Leibniz Universität Hannover“ in Hannover in September 2013, the 53rd European Regional Science Association Congress in Palermo in August 2013, the DRUID Academy Conference in Skørping in January 2013, the “Lenkungsausschuss starting business der Leibniz Universität Hannover“ in Hannover in December 2012, the Research Colloquium - 16th Forum Entrepreneurship Research (G-Forum) in Potsdam in November 2012, the “Jahrestreffen des Arbeitskreis Industriegeographie“ in Naurod-Niedernhausen in October 2011.

The following paragraphs describe the used data sources and also each chapter with the addressed research gaps and aims. Figure 3 provides an overview of the chapters.

CHAPTERS	CONCEPTUAL APPROACHES	DATA AND METHODS	EMPIRICAL ANALYSES
Chapter 1: Introduction			
Chapter 2: The entrepreneurial support structure at the universities in Hannover and Göttingen	Elements of the university's entrepreneurial support structure	USO Qualitative content analysis GUESSS Descriptive analyses	A comparison of the entrepreneurial support structure at the universities in Hannover and Göttingen
Chapter 3: Students' career attitudes – how entrepreneurial are prospective scientists?	Empirically based theory on career choice motives	GUESSS Multinomial and binary logistic regressions	The influence of students' career attitudes on their career choice intentions, differentiating between academia and entrepreneurship
Chapter 4: Longer is not necessarily better - career paths of academic entrepreneurs and university spin-off growth	Human capital University status Role identity	USO Qualitative content analysis Comparing extreme case analysis	The influence of the academic entrepreneur's career path on university spin-off growth
Chapter 5: Why do most university spin-offs remain small?	Growth willingness and growth ability Concept of growth phases	USO Qualitative content analysis Qualitative generation of types	The reasons why most university spin-offs remain small
Chapter 6: Conclusion including implications for policy and future research			

Figure 3: Overview of Chapters

Since the data on the entrepreneurial climate and activity at German universities is far from accurate, the data used in this dissertation was collected in the context of two research projects: one is based on a qualitative, the other on a quantitative approach. Both surveys were carried out in the year 2011. The qualitative data used in this dissertation was collected within the framework of a research project called “University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen” (USO). It was funded from 2010 to 2013 by the Ministry for Science and Culture of Lower Saxony, grant no. AZ. 76202-17-5/09. One objective of this project was to give an overview on university spin-off activities at the two chosen universities. The quantitative data used in this dissertation was collected in collaboration with the Global University Entrepreneurial Spirit Students’ Survey (GUESSS) 2012. GUESSS is an international annual online survey, which evaluates the entrepreneurial competence and activity of Bachelor, Master and PhD students (BERGMANN/CESINGER/OSTERTAG 2012). For this dissertation, I use the data on students at

the universities of Hannover and Göttingen. Further information on the specific data and methods used is provided in the respective chapters.

Chapter 2 provides a context-specific background for the subsequent chapters. Due to the fact that levels of university spin-off activities vary considerably across universities and regions (DI GREGORIO/SHANE 2003; O'SHEA/CHUGH/ALLEN 2008), this paper compares the entrepreneurial support structure and the entrepreneurial potential at the universities in Hannover and Göttingen. Relevant information on the universities is given in order to understand the special university context from which the academic entrepreneurs originate. On the one hand, interviews with key informants from the universities and regional organizations within the framework of the research project USO are conducted. On the other hand, data from a quantitative survey at the two universities within the framework of the Global University Entrepreneurial Spirit Students' Survey (GUESSS) is analyzed (BERGMANN/CESINGER/OSTERTAG 2012). The results show that only weak entrepreneurial support structures exist at the two universities. Correspondingly, individual characteristics and career paths of students and research staff may be of greater importance for the creation of university spin-offs.

Chapter 3 compares the entrepreneurial potential of prospective scientists to prospective entrepreneurs. Therefore the relationship between students' intentions of becoming scientists or entrepreneurs and their attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare are investigated. The study connects three streams of literature. One stream of literature deals with the career attitudes of (nascent) entrepreneurs in general (e.g. CARTER et al. 2003; SCHEINBERG/MACMILLAN 1988; SHANE/KOLVEREID/WESTHEAD 1991) and also with the self-employment intentions of students with a focus on the decision between entrepreneurship and employment (e.g. BERGMANN/CESINGER/OSTERTAG 2012; HAASE/LAUTENSCHLÄGER 2011; TKACHEV/KOLVEREID 1999; ZELLWEGER/SIEGER/HALTER 2011). The second stream of literature focuses on the reasons behind the decision of scientists to leave academia to establish a company (e.g. FINI/GRIMALDI/SOBRERO 2009; FRITSCH/KRABEL 2012; GÖTHNER et al. 2012; KRABEL/MUELLER 2009; LAM 2011; NÖRR 2010; STUART/DING 2006). The third stream of literature deals with the career attitudes of scientists (HAGSTROM 1975; MERTON 1973; STEPHAN/LEVIN 1992), to which little attention has been paid in recent years (SAUERMANN/ROACH 2012). Hence, a direct comparison of the career attitudes leading to entrepreneurship or science is to my best knowledge still absent from the literature. In order to

fill this research gap, I conducted a study which is based on quantitative data from the universities in Hannover and Göttingen and which was collected in the context of the Global University Entrepreneurial Spirit Students' Survey. The results show that prospective scientists and prospective entrepreneurs have similar career attitudes. This in turn indicates that entrepreneurs and scientists become increasingly different only after they start their careers due to the different socialization processes at a university or in a company. These findings justify investigating the university career paths of academic entrepreneurs more in-depth which is done in the following chapter.

Chapter 4 investigates how the career paths of academic entrepreneurs can influence university spin-off growth. The study approximates the central research question from three different research perspectives: human capital (BECKER 1975; LAZEAR 2005), university status (PHILLIPS/ZUCKERMAN 2001) and role identity (JAIN/GEORGE/MALTARICH 2009; MERTON 1973). The relationship between the career paths of entrepreneurs and growth intentions is still inconclusive. While some quantitative studies deny an influence (BIRLEY/WESTHEAD 1994; KOLVEREID 1992) others empirically prove it (CASSAR 2007). It should be noted that this relationship can hardly be investigated by quantitative analysis, because career paths are quite complex. They extend over a long period of time and many career decisions are path dependent and interrelated, so that they can hardly be forced into predefined rigid independent variables (DRUILHE/GARNSEY 2004; KODITHUWAKKU/ROSA 2002). For these reasons, my empirical analysis is based on qualitative survey data from the research project USO, which has proven to be a great advantage for analyzing the career paths of academic entrepreneurs and their influence on university spin-off growth. The results show that the university career paths of academic entrepreneurs affect their growth intentions and as a result university spin-off growth. This let me assume that it may be possible to identify different types of academic entrepreneurs and university spin-offs with regard to their growth willingness and growth ability. This was the inspiration for the following chapter.

Chapter 5 qualitatively investigates why many university spin-offs remain small. The subject of university spin-off growth is being controversially discussed in the literature (HELM/MAURONER 2007). A growing number of studies comes to the conclusion that the majority of university spin-offs remain small (ENSLEY/HMIELESKI 2005; NIGHTINGALE/COAD 2011). Also in high-tech clusters it appears that only a few university spin-offs have a high number of employees (LAWTON SMITH/HO 2006). Especially at mid-range universities located far from high-tech clusters, university spin-offs are a rather rare phenomenon and create only

a small number of jobs (DEGROOF/ROBERTS 2004; HARMON et al. 1997; HEMER et al. 2006). Again, a qualitative research design augments the mainly quantitative studies by investigating the growth paths of university spin-offs in more detail. It is possible to consider university spin-off path dependency and the interactions with a changing environment. For these reasons I use qualitative survey data from 68 academic entrepreneurs which was collected in the context of the USO research project. By comparing the academic entrepreneurs' willingness and the university spin-offs' ability to grow (DAVIDSSON 1989) four basic types of university spin-offs are derived: ambitious, unwilling, saturated and impeded. Against the backdrop of a concept of growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007) I furthermore identify eight different subtypes of university spin-offs: ambitious, standards, life stylists, entrepreneurial academics, hesitators, late bloomers, choked and survival artists.

2 The Entrepreneurial Support Structures at the Universities in Hannover and Göttingen⁶

Abstract

The levels of university spin-off activity vary considerably across universities and regions. An important factor influencing a university's ability to generate successful spin-off companies is the existence of a capable entrepreneurial support structure consisting of measures of support, infrastructural facilities, a positive entrepreneurial climate as well as specific and general university policies. The aim of this paper is to evaluate and compare the universities in Hannover and Göttingen in this respect and to investigate on the entrepreneurial potential of their students. The data and information stems from qualitative interviews with key informants as well as a quantitative survey among students of both universities. The results suggest that the entrepreneurial support structure at both universities still has a considerable upward potential. Thereby both universities have similar strength and weaknesses. While their support measures are well developed, they lack important infrastructural facilities, in particular an entrepreneurship professorship and an incubator. Furthermore, the entrepreneurial climate and the universities' general commitment for spin-off formation are relatively unsophisticated. In general, the entrepreneurial support structure at the university in Hannover is slightly better developed than in Göttingen. Regarding the entrepreneurial potential of the students of both universities there is still an upward potential.

2.1 Introduction

Universities are increasingly seen as engines for regional innovation and economic growth (ETZKOWITZ 2008; LAWTON SMITH 2007; MUSTAR/WRIGHT/CLARYSSE 2008). While they are traditionally understood as sites for basic research and higher education, the contemporary view is that they increasingly integrate with the regional economy via different channels of knowledge and technology transfer. 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 (SAXENIAN 1983; STERNBERG

⁶ This chapter was written together with Arne Vorderwülbecke, Institute of Economic and Cultural Geography, Leibniz Universität Hannover. Both authors contributed equally to the chapter.

2010). In these regions, university spin-offs are regarded as one important vehicle of knowledge transfer and commercialization from university to industry.

Universities and regions dedicated to the facilitation of spin-off activities need a supportive environment. Important in this respect are the general characteristics of the university (e.g. size, structure of scientific disciplines and quality of research and teaching) and the regional context (e.g. economic performance, industry-structure, entrepreneurial regime). Particularly crucial is the existence of a capable university entrepreneurial support structure. In this respect, studies suggest that in order to be conducive for spin-off formation, specific cultural attributes, practical routines as well as measures and organizations of support need to be implemented at a university (e.g. business incubators or training, coaching and consultation programs) (O'SHEA et al. 2005; ROTHARMEL/AGUNG/JIANG 2007).

The aim of this paper is to compare the entrepreneurial support structure and entrepreneurial potential at the universities in Hannover and Göttingen, the two biggest universities in Lower Saxony, Germany, measured by the number of students (KULICKE et al. 2008). In this way, background information on the universities is provided for the following chapters in order to understand the special university context from which the academic entrepreneurs originate.

Our empirical analysis is based on two research projects: one targets a qualitative, the other a quantitative approach. The qualitative research project "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen" (USO)⁷ provides data from semi-structured face-to-face interviews with 25 key informants from university and regional organizations in Hannover and Göttingen. The quantitative research project "Global University Entrepreneurial Spirit Students' Survey" (GUESSSS)⁸ provides data on the entrepreneurial attitude, competence and activity of 3,151 students at the universities of Hannover and Göttingen and their perception of a university's entrepreneurial programs and climate. The subsequent analytical process relies on a content analysis of the qualitative data and a descriptive analysis of the quantitative data.

The results suggest that at both universities the entrepreneurial support structure still has a considerable upward potential. Both universities face similar strengths and weaknesses. While their support measures are well developed, they lack important infrastructural facilities, in particular an entrepreneurship professorship and an incubator. Furthermore, their entrepreneurial climate and the universities' general commitment for spin-off formation are

⁷ See acknowledgements at the end of the chapter.

⁸ See acknowledgements at the end of the chapter.

not very sophisticated. In general, the entrepreneurial support structure of the university in Hannover is slightly better developed than in Göttingen. Regarding the entrepreneurial potential of the students of both universities there is still an upward potential.

This paper is structured as followed: First, the importance of the university environment for university spin-offs is discussed and its single elements are explained in a conceptual framework (Chapter 2.2). Then, after describing the data and methods used for the analysis (Chapter 2.3), the empirical results according to the different elements of a university's entrepreneurial support structure are presented by comparing the two universities (Chapter 2.4). The last empirical chapter focuses on the entrepreneurial potential. Finally, the paper concludes with a summary of the results, policy implications and indications for further research (Chapter 2.5).

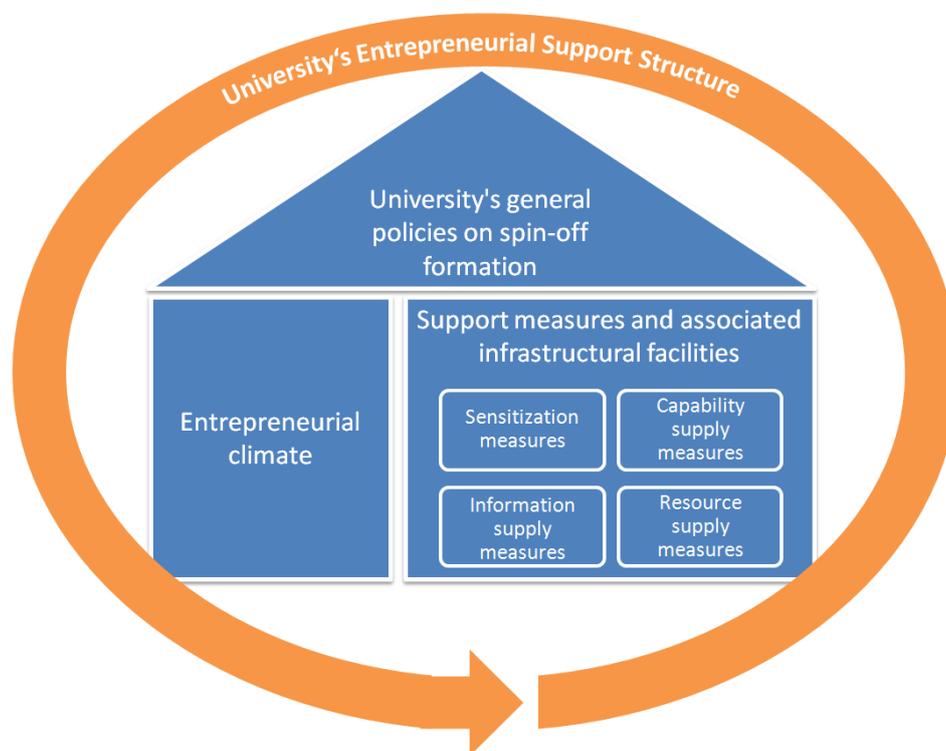
2.2 The Importance of the University Environment for Spin-off Formation

While factors like founder personality, firm characteristics, broader (national) legal conditions (DI GREGORIO/SHANE 2003) and the regional surrounding of a university (GUPTA 2007; HEMER/SCHLEINKOFER/GÖTHNER 2007; LANDRY/AMARA/RHERRAD 2006; O'SHEA/CHUGH/ALLEN 2008; SHANE 2004) certainly play a significant role, the state of research suggests that it is mainly the characteristics of a university itself, that determine the dynamics of spin-off formation and the performance of the respective start-ups (LOCKETT/WRIGHT/FRANKLIN 2003).

A business idea for a university spin-off usually originates from technological and knowledge resources that a founder obtains while studying or researching at a university (DRUILHE/GARNSEY 2004). Consequently, the basis for spin-off activity resides in a university's stock of knowledge and technology (GRAS et al. 2008; SHANE/STUART 2002). A university's characteristics such as its size and tradition, its nature and quality of research and teaching, its ability to attract financial resources and forms of cooperation with industry partners, mirror a university's stock of commercialized knowledge and technology and therefore determine the frequency and quality of spin-off activities (DI GREGORIO/SHANE 2003; LANDRY/AMARA/RHERRAD 2006; LOCKETT/WRIGHT 2005; O'SHEA et al. 2005; O'SHEA/CHUGH/ALLEN 2008; POWERS/MCDOUGALL 2005; SHANE 2004; WRIGHT/BIRLEY/MOSEY 2004; ZUCKER/DARBY/BREWER 1998). For instance, as not all subjects are equally well-suited for commercialization, universities focusing on technical and

natural sciences subjects as well as on economics and business administration are rather more inclined towards spin-off formation than those with a tradition in social sciences and humanities (O'SHEA et al. 2005). Furthermore, the more a university applies industry-funded than public-funded research, the higher the probability of generating spin-off companies will be (BLUMENTHAL et al. 1996).

The singularity and exclusivity of the knowledge and technology a spin-off company receives from a university holds a competitive advantage over other business entrepreneurs (DRUILHE/GARNSEY 2004). In spite of this competitive advantage, academic entrepreneurs usually face a shortage of other necessary resources, capabilities and information during the process of spinoff formation - such as entrepreneurial skills and thinking, market information and financial resources - to develop the business idea and the associated product, to gain market maturity, and to manage the start-up process (DRUILHE/GARNSEY 2004; POWERS/MCDOUGALL 2005). Furthermore, scientific staff and students often lack the motivation to become self-employed (SHANE 2004). A university has the potential to provide these missing resources, capabilities and information by establishing a supportive environment consisting of an organizational and institutional infrastructure as well as specific measures of support (DEGROOF/ROBERTS 2004; POWERS/MCDOUGALL 2005; RASMUSSEN/BORCH 2010).



Source: Own illustration.

Figure 4: Elements of the University's Entrepreneurial Support Structure

A literature summary shows that a capable university's entrepreneurial support structure comprises three elements (see Figure 4). Firstly, for a university dedicated to fostering spin-off activities a positive *entrepreneurial climate* (in the literature sometimes also referred to as entrepreneurial culture) is crucial. In a nutshell, when faculty and students encounter a climate which advocates commercialization and entrepreneurship, they are more likely to develop and realize start-up ideas (GUERRERO/URBANO 2012; NDONZUAU/PIRNAY/SURLEMONT 2002; SHANE 2004; SIEGEL et al. 2003). Furthermore, the start-up is more likely to perform successfully (GUPTE 2007).

Secondly, practical experience and academic research suggest that a university intending to increase the number and quality of spin-offs needs to establish several *support measures and associated infrastructural facilities*. In general four important support measures can be differentiated. *Sensitization measures* target at fostering motivation and attitudes towards entrepreneurship among faculty and staff by increasing the awareness of entrepreneurship as a possible and desirable career choice. Thereby these measures indirectly also improve a university's entrepreneurial climate (FINI et al. 2011; KULICKE/DORNBUSCH/SCHLEINKOFER 2011). *Information supply measures* in the form of advisory and consultation programs can equip (potential) academic entrepreneurs with expertise and assistance in areas such as the identification of business ideas, the assessment of their commercial and technological market potential, the definition of the most suitable way to exploit the idea, legal protection and ownership rights of the business idea, and the development of a sophisticated business plan (NDONZUAU/PIRNAY/SURLEMONT 2002; O'SHEA et al. 2005; SHANE 2004; VOHORA/WRIGHT/LOCKETT 2004). Furthermore, a university can also set up (potential) spin-off entrepreneurs with the necessary skills and capabilities in the areas mentioned above. These *capability supply measures* may include an entrepreneurship education program within a university's curricula or training and qualification programs for those students or scientists in the process of setting up a business. As a side effect, capability supply measures also foster a university's entrepreneurial climate by supporting entrepreneurial thinking and attitudes among its students and staff (ASTEBRO/BAZZAZIAN 2011; GUERRERO/URBANO 2012; KULICKE/DORNBUSCH/SCHLEINKOFER 2011). Studies suggest that for an efficient implementation and realization of sensitization activities as well as information supply, and capability supply measures, a university should establish certain infrastructural facilities, such as a technology transfer office, an entrepreneurship office or an entrepreneurship professorship (DJOKOVIC/SOUTARIS 2008; GUERRERO/URBANO 2012; WRIGHT et al. 2007). Finally, *resource supply measures* target at supplying (potential) spin-off entrepreneurs with

scarce but necessary financial or material resources. Regarding the former, a university can support its spin-off entrepreneurs financially by simple cost absorption, by taking equity in a spin-off firm or by the more sophisticated establishment of a venture capital fund (DI GREGORIO/SHANE 2003; WRIGHT et al. 2007; WRIGHT/VOHORA/LOCKETT 2002). As for material resources, a university should establish specific rules and flexible arrangements to allow (potential) academic entrepreneurs to access university resources such as laboratories, scientific equipment and office space (FINI et al. 2011; HELM/MAURONER 2007; SHANE 2004). More sophisticated infrastructural facilities for making material resources more accessible to early spin-off firms could be a university-affiliated business incubator or a science and technology park (DI GREGORIO/SHANE 2003; DJOKOVIC/SOUITARIS 2008).

The entrepreneurship expertise within the regional context (in the form of e.g. investors, consultants, chambers of commerce, agencies of economic development or business incubators) can serve as an additional source of information, capabilities and resources for (potential) spin-off entrepreneurs. A university should assist in connecting (potential) spin-off entrepreneurs with these actors by establishing and cultivating networks (O'SHEA et al. 2005; SHANE 2004).

Thirdly, a university's climate regarding entrepreneurship as well as its entrepreneurship support measures and associated infrastructural elements can only be developed and can only function effectively when they are backed by *a university's general policies on spin-off formation*. Most important in this respect is the general commitment of a university to the commercialization of university knowledge and technology via spin-off formation (ASTEBRO/BAZZAZIAN/BRAGUINSKY 2012). In addition, the literature identifies a set of specific rules, arrangements and unwritten norms which a university should establish in order to encourage its scientific staff and students to exploit intellectual property and engage in spin-off activities (ASTEBRO/BAZZAZIAN/BRAGUINSKY 2012; DI GREGORIO/SHANE 2003; FINI et al. 2011; SHANE 2004). In addition to the aforementioned procedures to support spin-offs by taking equity or by allowing them to access university infrastructure (HELM/MAURONER 2007; LOCKETT/WRIGHT/FRANKLIN 2003), a university should facilitate the exploitation of university-assigned knowledge and technologies by offering exclusive licenses and patent rights to academic entrepreneurs, by introducing specific contractual arrangements with scientific staff starting up a business (e.g. leave of absence or part-time employment) (FINI et al. 2011; MUSTAR/WRIGHT/CLARYSSE 2008) and establishing incentive structures that reward entrepreneurial activity (O'SHEA et al. 2005).

It is important that the three elements of a university's entrepreneurial support structure should not be considered separately, but that they interact. There is for example a nexus between a university's climate and the other two support structure elements, in that an entrepreneurial climate is also reflected by a university's general commitment towards commercialization and entrepreneurial activities. This in turn constitutes if and to what extent measures of support, associated organizations as well as specific policies on spin-off formation are implemented. On the other hand, a strong commitment of a university towards entrepreneurship and effective rules, arrangements and unwritten norms positively influence faculties' and students' attitudes towards spin-off formation and improves a university's entrepreneurial climate. Furthermore, sensitization measures as well as capability supply measures (particularly an entrepreneurship education program and an entrepreneurship professorship) support entrepreneurial thinking and attitudes among students and staff and thereby foster a positive entrepreneurial climate.

Within the frame of this study, which is to compare the entrepreneurial support structure and entrepreneurial potential at the universities in Hannover and Göttingen, and to characterize the conceptual framework on the importance of a university's entrepreneurial support structure and its different elements, four research questions are proposed:

- 1. How can the support measures and infrastructural facilities be characterized at the universities in Hannover and Göttingen in comparison?*
- 2. How can the university policies on spin-off formation be characterized at the universities in Hannover and Göttingen in comparison?*
- 3. How can the entrepreneurial climate be characterized at the universities in Hannover and Göttingen in comparison?*
- 4. How prevalent is the entrepreneurial potential among the students at the universities in Hannover and Göttingen in comparison?*

In order to analyze these research questions, it should be considered that the field of study a student chooses influences the students' perceptions of the entrepreneurial climate, entrepreneurial programs as well as his/her entrepreneurial intention. As mentioned above, not all subjects are equally well-suited for commercialization. Students in technical and natural sciences subjects as well as in economics and business administration are rather more inclined towards spin-off formation than those studying social sciences and humanities (O'SHEA et al. 2005).

2.3 Data

In this paper, the entrepreneurial support structures and the entrepreneurial potential of the Leibniz Universität Hannover (LUH) and the Georg-August-Universität Göttingen (GAUG) are compared. The data that German universities can provide directly on the entrepreneurial support structures and entrepreneurial potential may be far from accurate. Therefore the data used in this paper was collected in the context of surveys from two research projects: one is based on a qualitative, the other on a quantitative approach. All information on the universities in Hannover and Göttingen were collected in 2011. The following subchapter presents the spin-off formation related characteristics of both universities. Afterwards the data sources used for characterizing the different elements of the universities' entrepreneurial support structures are described.

2.3.1 General Characteristics of the Universities under Investigation

A university's general characteristics such as its size, its tradition and nature of research and teaching, its frequency of cooperation with industry partners, as well as the amount of industry-funded research determine the spin-off dynamics of a university (DI GREGORIO/SHANE 2003; LANDRY/AMARA/RHERRAD 2006; LOCKETT/WRIGHT 2005; O'SHEA et al. 2005; O'SHEA/CHUGH/ALLEN 2008; POWERS/MCDOUGALL 2005; SHANE 2004; WRIGHT/BIRLEY/MOSEY 2004; ZUCKER/DARBY/BREWER 1998). Thus, before examining the entrepreneurial support structure at the universities in Hannover and Göttingen, the general characteristics of both universities should be considered.

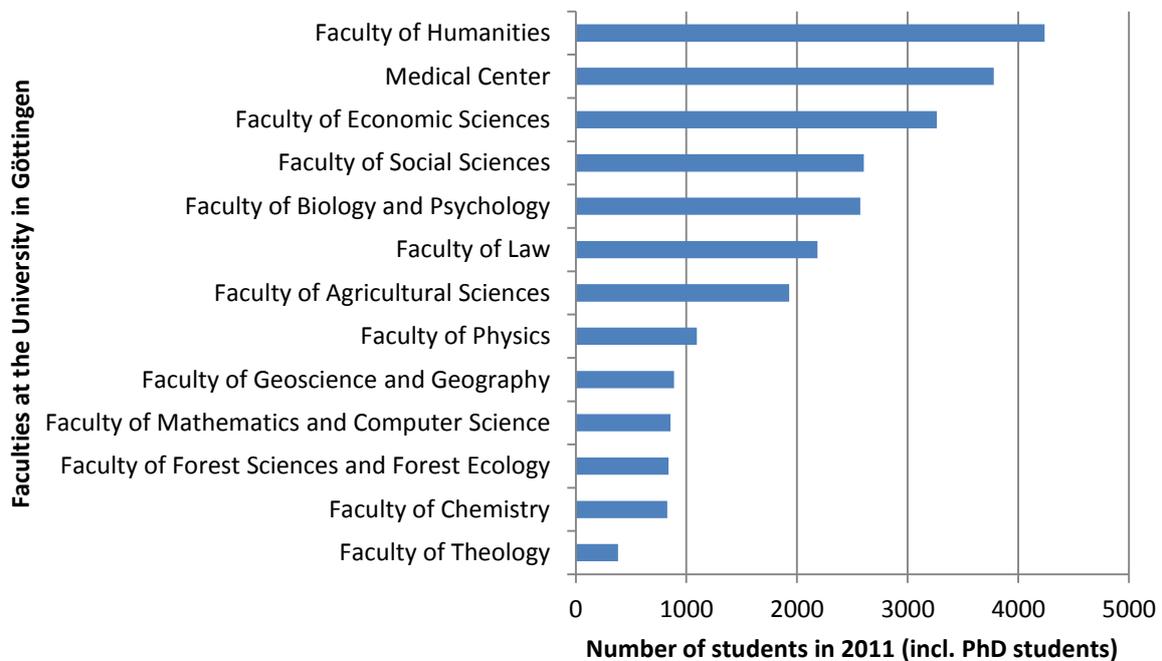
Regarding enrolment rates as an indicator for size, the universities in Hannover and Göttingen are the two biggest universities in Lower Saxony. In October 2011, 25,459 students (including PhD students) were enrolled at the university in Göttingen (including its medical center) (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014a) and 21,530 students (including PhD students) studied at the university in Hannover (LEIBNIZ UNIVERSITÄT HANNOVER 2012). Both universities belong to the larger German universities, while Göttingen ranks 22nd and Hannover 31st among the 110 universities in Germany⁹ (FEDERAL BUREAU OF STATISTICS 2014). In regards to scientific staff, the university in Göttingen has 3,972 scientists¹⁰ and is

⁹ The list includes private universities but no universities of applied sciences, theological colleges, art colleges, universities of public administration and universities of education.

¹⁰ It has to be taken into account that the number for the university in Göttingen includes 1,545 employees at its medical center.

considerably larger than Hannover with 2,509 (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014b; LEIBNIZ UNIVERSITÄT HANNOVER 2012).

There are considerable differences in the tradition of research and teaching between the two universities, which are still mirrored in faculty structure, education programs and research focus. While Göttingen also offers natural sciences, it traditionally has a stronger focus on humanities, social sciences, economic sciences and law. These faculties belong to the six largest among Göttingen’s 13 faculties, when considering the number of students (see Figure 5). A specialty of Göttingen is that it includes a medical center, which is the second largest faculty. However, Göttingen has no research or teaching program in technical subjects (e.g. mechanical, civil or electrical engineering) (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014a).

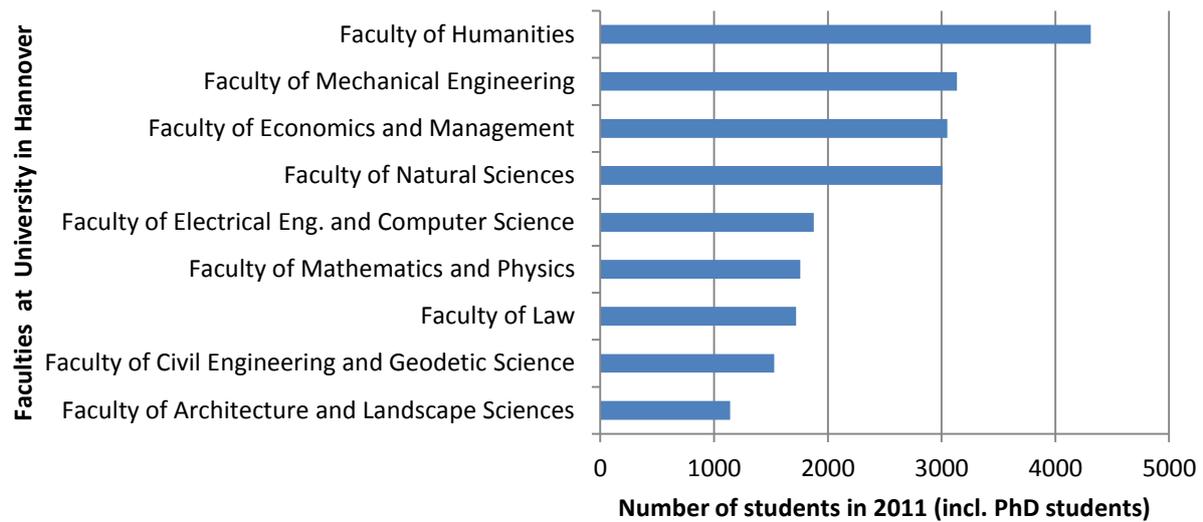


Valid cases: 25,459

Source: GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN (2014a)

Figure 5: Number of Students at the University in Göttingen according to Faculties

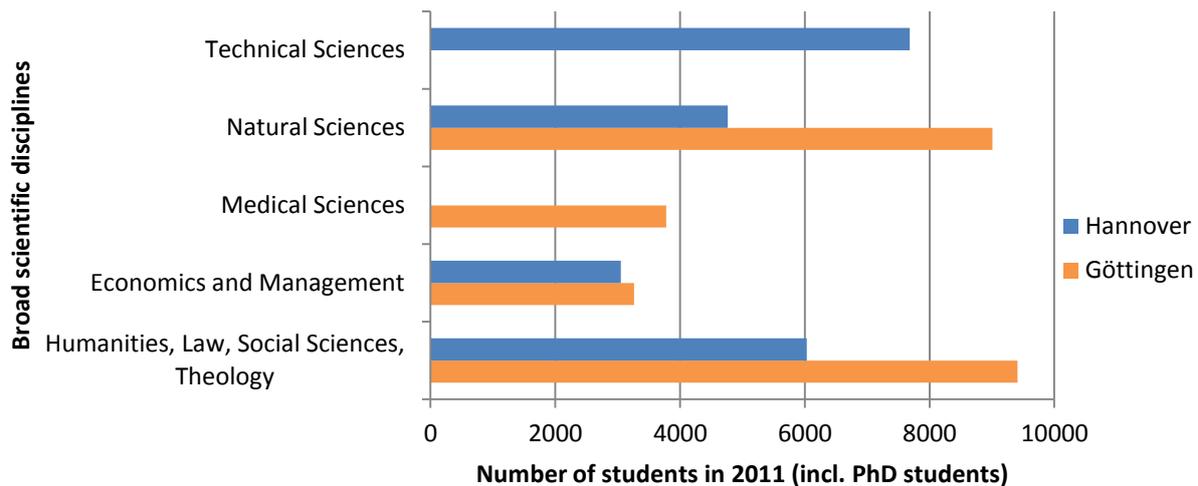
On the other hand, the university in Hannover traditionally has a focus on technical subjects, while also offering programs in natural sciences, social sciences, humanities, law, economics and management (see Figure 6). In fact, one third of all students are enrolled in the Faculties of Mechanical Engineering, Electrical Engineering and Computer Science, Civil Engineering and Geodetic Science or Architecture and Landscape Sciences. In contrast to Göttingen, the university in Hannover does not have a medical center (LEIBNIZ UNIVERSITÄT HANNOVER 2012).



Valid cases: 21,530
 Source: LEIBNIZ UNIVERSITÄT HANNOVER (2012)

Figure 6: Number of Students at the University in Hannover according to Faculties

As already mentioned above, not all scientific disciplines are equally inclined towards commercialization and spin-off formation. In general, technical sciences (e.g. mechanical, civic and electrical engineering, architecture), natural sciences (e.g. chemistry, biology, physics), medical sciences, economics and management are considered to have a higher spin-off potential than humanities or social sciences (O'SHEA et al. 2005). When aggregating the number of students in the different faculties into these broad scientific disciplines, the universities' structural differences are revealed (see Figure 7). While Hannover's strength in comparison to Göttingen are the technical sciences, Göttingen has more students in natural and medical sciences as well as in the aggregated category of humanities, law, social sciences and theology (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014a; LEIBNIZ UNIVERSITÄT HANNOVER 2012).



Valid cases: Hannover: 21,530; Göttingen: 25,459

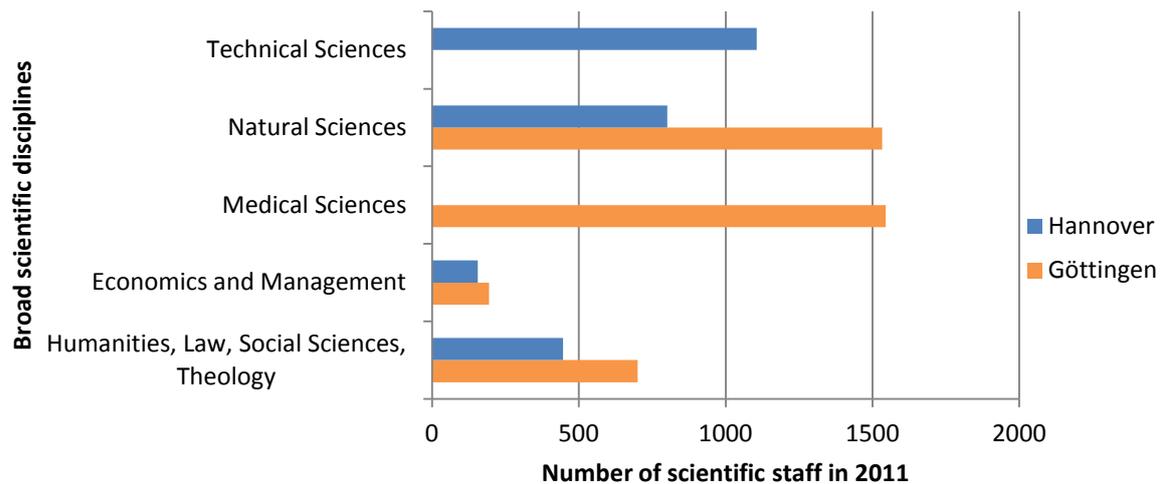
Source: LEIBNIZ UNIVERSITÄT HANNOVER (2012), GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN (2014a)

Figure 7: Number of Students at the Universities in Hannover and Göttingen according to Broad Scientific Disciplines

In spite of these structural differences, Hannover and Göttingen have a similar spin-off potential when considering the total number of students in technical, natural and medical sciences (so-called MINT subjects¹¹) as well as economics and management. The number of students enrolled in MINT subjects is 12,447 at the university in Hannover and 12,787 at the university in Göttingen. The respective numbers for students enrolled in economics and management are 3,050 in Hannover and 3,264 in Göttingen. The share of students enrolled in MINT subjects is higher in Hannover than in Göttingen. This is due to the fact that a considerable higher number of students is enrolled in humanities, law, social sciences and theology in Göttingen (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014a; LEIBNIZ UNIVERSITÄT HANNOVER 2012)

The differences between the two universities regarding their scientific disciplines also apply for their scientific staff (see Figure 8). While the university in Hannover has a comparative advantage in technical sciences, Göttingen employs more scientists in the areas natural sciences, medical sciences, humanities and law (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2014b; LEIBNIZ UNIVERSITÄT HANNOVER 2012).

¹¹ MINT subjects include mathematics, computer science, natural science and engineering. They are comparable to the STEM fields used in English. These comprise science, technology, engineering and mathematics. In the following also medical sciences is included.



Valid cases: Hannover: 2,504; Göttingen: 3,972

Source: LEIBNIZ UNIVERSITÄT HANNOVER (2012), GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN (2014b)

Figure 8: Number of Scientific Staff at the Universities in Hannover and Göttingen according to Broad Scientific Disciplines

As mentioned above, studies suggest that a university's ability to successfully attract external third party research funding, especially industry funding will increase the probability of generating spin-off companies. The rationale is that results from industry funded research are in general more commercially usable than those that are publicly funded (BLUMENTHAL et al. 1996). Regarding this issues Hannover performs better than Göttingen. In 2011 the university in Hannover raised industry-funds in the amount to 13.1 Mio. Euro, which constitutes 3.3% of its overall revenues (LEIBNIZ UNIVERSITÄT HANNOVER 2012). The industry funds at the university in Göttingen are considerably lower at 8.8 Mio. Euro. The share of industry funds of Göttingen's overall revenues is 0.8%. This low share is due to the high amount of public funding for its medical center. However, when excluding the medical center from the calculations the share is still only at 1.6% (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2012).

2.3.2 Interviews with Key Informants

In order to characterize the entrepreneurial support measures (first research question) and the general policies on spin-off formation (second research question) at the universities in Hannover and Göttingen, a qualitative research design was chosen. The data was collected within the framework of the research project "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen" (USO).¹² This project included among others data from semi structured face-to-face interviews with 25 key informants (13 in Hannover and 12 in Göttingen). Key informants either worked in the past in

¹² See acknowledgements at the end of the chapter.

or still are affiliated with an organization and position, in which they directly deal with the universities' entrepreneurial support structures. These include the universities' technology transfer offices, the universities' management and administration, Hannover's and Göttingen's economic development agencies, the Lower Saxony's Ministry of Economics, Employment and Traffic as well as its Ministry of Science, Education and Culture. In order to clarify and verify certain aspects, the respective key informants were contacted several times during the data collection and analysis period. Thus, the interviews ranged from a few minutes for short supplementary queries to one and a half hours in length. The interviews were recorded and transcribed.

The transcribed interviews were examined using typical content analysis procedures (GLÄSER/LAUDEL 2009; MAYRING 2008a, 2008b), supported by the qualitative data analysis software NVivo. As the relevant categories of a university's entrepreneurial support structure were already theoretically pre-defined (see Figure 4), the procedure of deductive category application was employed (KELLE/KLUGE 1999; KUCKARTZ 2012; SCHREIER 2012). Thereby categories derived from theoretical considerations were used as a basis to structure the transcript material.

In addition to the interviews with key informants, information from archival sources, such as the annual activity reports of the universities' technology transfer and entrepreneurship offices, studies, presentations, brochures and strategy documents were collected and analyzed.

2.3.3 Students' Survey

In order to analyze the students' perceptions of the entrepreneurial support measures (first research question) and entrepreneurial climate (third research question) as well as the entrepreneurial potential (fourth research question) at the two universities, a quantitative research design was chosen. The data was collected within the framework of the research project "Global University Entrepreneurial Spirit Students' Survey" (GUESSSS). GUESSSS is an international annual online survey, which evaluates the entrepreneurial competence and activity of Bachelor, Master and PhD students (BERGMANN/CESINGER/OSTERTAG 2012). For the current study, we use the data which was collected in 2011 at the universities in Hannover and Göttingen. In that year, both universities had the greatest number of cases in the German GUESSSS with a total of 3151 interviewed students. The response rate for the university of Hannover was 7,9 % and for the university of Göttingen 6,5 % (BERGMANN/CESINGER/OSTERTAG 2012). Compared to other online surveys addressing students (e.g. JOSTEN et al. 2008) the response rate is quite satisfactory.

In order to evaluate the entrepreneurial support measures (first research question), the students were asked whether they know and attended entrepreneurial programs at the university. According to the assessment of the entrepreneurial climate (third research question), the students were asked how much they agree with the statement, that there is a favorable climate and premises for becoming an entrepreneur at their university. For the rating of the entrepreneurial climate a seven point Likert scale from 1 = “strongly disagree” to 7 = “strongly agree” was used. Regarding the entrepreneurial potential (fourth research question), the students were asked to indicate if and how seriously they have been thinking about founding a business. Here, a nine point Likert scale from 1 = “never” to 9 = “I have already founded more than one company” was used.

In the analyses the students of the two universities are differentiated according to their fields of studies, as already mentioned in Chapter 2.2. The fields of studies comprise three broad categories: business and economics, natural sciences, and social sciences. The field of business and economics comprise economics, management and business administration. The field of natural science include medicine, health science, mathematics, natural sciences, engineering sciences, architecture, computer sciences and informatics. Thus, the category of natural sciences includes the so-called MINT subjects, which are considered to have a high entrepreneurial potential. The category of social sciences comprise linguistics, religion, philosophy, psychology, education, pedagogy, sociology, political science and other social sciences.

Furthermore, it should be noted that the students’ entrepreneurial intentions might also influence the field of study a student chooses, the perception of the entrepreneurial climate and the perception of the entrepreneurial support measures. The students are therefore also differentiated according to their entrepreneurial intentions. They are divided into three types: students without entrepreneurial intentions, students with entrepreneurial intentions and active founders. Students without entrepreneurial intentions never or only sketchily thought about founding a company. Students with entrepreneurial intentions have at least repeatedly thought about starting a business or have already started to found a company. Active founders are students, who are already self-employed in one or more companies.

2.4 Empirical Findings on the Entrepreneurial Support Structure at the Universities in Hannover and Göttingen

This chapter aims describes the entrepreneurial support structure at the universities in Hannover and Göttingen in the year 2011. As illustrated in Chapter 2.2, a university's entrepreneurial support structure contains three elements: its entrepreneurial climate, its entrepreneurship related support measures and the affiliated infrastructural facilities, as well as its general policies on spin-off formation. In the following these three elements are characterized. Consequently, Chapter 2.4.1 deals with to the support measures and associated infrastructural facilities. Chapter 2.4.1.1 shows how these can be described at both universities. Not only the existence of a support infrastructure per se but also its perception by students and scientists exert an influence on spin-off formation. Thus, Chapter 2.4.1.2 analyzes the students' perceptions in this respect. Chapter 2.4.2 illustrates both universities' general policies on spin-off formation. Chapter 2.4.3 describes the entrepreneurial climate at both. Finally, Chapter 2.4.4 deals with the entrepreneurial intentions of the students.

2.4.1 Support Measures and Associated Infrastructural Facilities

One important element of a university's entrepreneurial support structure is entrepreneurial support measures and infrastructural facilities (see Chapter 2.2). These support measures can help to increase the entrepreneurial activity at a university and the quality of the spin-offs (FINI et al. 2011; KULICKE/DORNBUSCH/SCHLEINKOFER 2011).

2.4.1.1 Statements by Key Informants

At both universities various spin-off support measures and associated infrastructural facilities have existed for more than ten years. Thereby, the central and most important infrastructural facility at both universities are their entrepreneurship offices. The entrepreneurship offices' general aim is to increase the number of innovative and marketable spin-off companies (OETZMANN 2012; key inf. 13, 14). The entrepreneurship offices of both universities are affiliated with the universities' technology transfer offices (key inf. 2, 9, 14). The entrepreneurship office at the university in Hannover comprises two employees (1.5 full-time positions) and is financed by a German federal spin-off support program (EXIST) as well as a support program of the federal state Lower Saxony (Gründercampus plus). The entrepreneurship office at the university in Göttingen also has two employees (1 full-time position), financed by the university budget as well as the European Regional Development Fund (ERDF).

At both universities the entrepreneurship offices are in charge of organizing the universities' entrepreneurial support measures. Overall, these are well developed. All of the important support measures listed in Chapter 2.2 exist: sensitization, information, capability as well as resource supply measures.

The entrepreneurship sensitization measures at both universities have three intentions. Firstly, as sensitization measures are those support measures that are most visible and therefore most easily perceived by students, scientists and external individuals, they aim at "*...putting the topic on the agenda of the university.*" (key inf. 2), according to one employee of the entrepreneurship office in Hannover. The second aim is to increase the awareness of self-employment as a possible and desirable career choice among the students and staff and thus to mobilize as many of them to start-up a company. The idea is that as a side effect the motivation and attitudes towards entrepreneurship are improved, with the intention to establish a positive entrepreneurial climate at the universities. Thirdly, the sensitization efforts aim at making the information supply, capability supply and resource supply measures of the entrepreneurship offices known among the students and staff. In order to reach these aims, the entrepreneurship offices at both universities implement various activities, such as maintaining information desks within the university buildings, the distribution of information flyers and posters, the presentation of its programs and of successful spin-off entrepreneurs in lectures, seminars and at different university events (e.g. the orientation week in the beginning of each semester, events regarding career planning and job fairs), as well as intensive public relations (key inf. 2, 14, 20).

A comparative advantage of Hannover's entrepreneurial sensitization measures is the employment of four professional start-up scouts (Gründungsscouts) within the faculties of natural sciences, mechanical engineering, electrical engineering and computer sciences, as well as mathematics and physics. In addition to the above mentioned centralized sensitization and mobilization activities, the start-up scouts' task is to implement the topic of spin-off formation and self-employment within the faculties. Therefore they actively visit lectures and seminars, organize faculty specific events and stay in close personal contact with students and scientists (key inf. 9; OETZMANN 2012). As several key informants state, the employment of the start-up scouts turns out to be a very successful and effective sensitization measure (key inf. 2, 9, 13). In contrast, the university in Göttingen has no such professional scouts on faculty level.

The spin-off support measures of both universities have very well developed information supply measures. By offering personal advisory and consultation programs, (potential) spin-off entrepreneurs are equipped with expertise and assistance in the following areas: assessment of the technological and commercial market potential of the business idea, customer acquisition, support and financing opportunities, application to support programs, legal protection and ownership rights, as well as business plan development. In general, the spectrum of the entrepreneurship offices' activities ranges from a first consulting session to a longer term supporting accompaniment. However, in practice, the focus usually is on initial advice, while for more in-depth assistance in particular fields, (potential) academic entrepreneurs are sent to regional partners (see below) (key inf. 2, 9, 14, 20; OETZMANN 2012). Göttingen's information supply measures are furthermore upgraded by the existence of a university affiliated organization (MBM ScienceBridge), which is specialized in issues such as legal protection, ownership rights as well as patenting of university knowledge and technologies (key inf. 14, 20).

As explained in Chapter 2.2, a university may not only provide information but also set up (potential) spin-off entrepreneurs with the necessary skills and capabilities within the framework of capability supply measures. These may consist of an entrepreneurship education program within a university's curricula or trainings and qualification programs for those students or scientists in the process of setting up a business. The entrepreneurship office at the university in Hannover organizes quite a range of trainings and qualification programs, including workshops in areas such as business plan development or legal protection (key inf. 2). In contrast, the entrepreneurship office at the university in Göttingen offers qualification and training programs only at a very small scale. Instead, (potential) spin-off entrepreneurs who demand qualification are usually sent to regional partners, such as the local chamber of industry and commerce (see below) (key inf. 14). Regarding curricular entrepreneurship education both universities do not have a conclusive entrepreneurship program. However, their curricula includes seminars on entrepreneurship related topics that are optional for students. In this respect, a major shortcoming of the entrepreneurial support structures at both universities is that they do not have an entrepreneurship professorship as an infrastructural facility (key inf. 2, 9, 14).

As explained in Chapter 2.2, universities can supply (potential) spin-off entrepreneurs directly with scarce but necessary financial or material resources. In the case of the universities in Hannover and Göttingen, these resource supply measures are the less developed within the

four measures of support. Regarding financial resources, the university in Göttingen together with industry partners established a university venture capital fund (Innovations-Capital Göttingen GmbH) in 2001, as the first university in Germany. Its focus is on pre-seed, seed and start-up capital for academic entrepreneurs from the areas of life sciences, physics and other natural sciences. However, the funds' impact can be considered to be rather limited, as it has invested only in a very small number of companies since its establishment. As a consequence of financial losses, the venture capital fund has been inactive for several years (key inf. 14, 16, 19, 20). The university in Hannover has never established a venture capital funding or invested equity into a spin-off company, partly due to financial constraints and different priorities of investments (e.g. research personnel or facility infrastructure) (key inf. 1, 7, 12). In addition to the inadequacies regarding financial resource supply capabilities, the material resource supply capabilities are also underdeveloped at both universities. In particular, they both lack a business incubator with office space on the campus. In order to compensate for this infrastructural gap, the entrepreneurship offices support the use of office space and scientific equipment within the universities' institutes and departments (key inf. 7, 9, 20). In addition, several business incubators and technology parks exist in both university regions, to which academic entrepreneurs have access and are sent to by the universities' entrepreneurship offices (key inf. 1, 2, 7, 8, 9, 13, 20). Hannover's material resource supply capability especially profits from two university affiliated institutes. The Hannover Centre for Production Technology (PZH) and the Laser Center Hannover (LZH) provide office space and access to laboratories and scientific equipment for start-ups in the sectors of production and laser technology (key inf. 1, 2, 8, 9, 13). Göttingen's material resource supply capability profits from an incubator of another higher education institution in the direct neighborhood of the campus, to which also university spin-off entrepreneurs have access, provided the incubator has capacities (key inf. 14, 15, 20).

As laid out in Chapter 2.2, the entrepreneurship expertise and infrastructure within the regional context can serve as an additional source of information, skills and resources for (potential) spin-off entrepreneurs. Thus, a university should assist (potential) spin-off entrepreneurs in connecting with the respective actors by establishing and cultivating networks (O'SHEA et al. 2005; SHANE 2004). In fact, such a network approach is an important aspect of the entrepreneurial support structures at the universities in Hannover and Göttingen. In this respect, many information and capability supply measures are organized and realized in close cooperation with regional partners, such as Hannover's and Göttingen's economic development agencies, local banks or the chamber of industry and commerce (key inf. 2, 6, 9,

10, 12, 13, 14, 15, 20). Further cooperation occurs as the universities' entrepreneurship offices send (potential) spin-off entrepreneurs to regional partners for in-depth consultation and advisory (key inf. 2, 9, 14, 20; OETZMANN 2012). Also, as already indicated above, regional organizations serve as a substitute for the universities' inadequacies regarding resource supply facilities, especially a university incubator (key inf. 1, 2, 7, 8, 9, 13, 14, 15, 20). In the case of the university in Göttingen, regional partners are particularly important regarding its limited entrepreneurship qualification programs. In this respect, (potential) spin-off entrepreneurs demanding qualification programs are sent to regional partners, such as the chamber of industry and commerce (key inf. 14, 15, 20).

In summary, the characteristics of the universities' entrepreneurial support measures as well as the affiliated infrastructural facilities are quite similar (see Table 1). At both universities the support measures are well developed and a number of sensitization, information supply, capability supply and resource supply measures are offered. In regards to the start-up scouts within the faculties, the sensitization efforts are more sophisticated at the university in Hannover than in Göttingen. Furthermore, the programs regarding qualification and training are broader in Hannover. While the support measures can be considered an asset of the entrepreneurial support structure at both universities, the affiliated infrastructural facilities represent a serious inadequacy. While both universities have technology transfer offices and entrepreneurship offices, they lack an entrepreneurship professorship as well as an incubator. This shortcoming can at least partially be compensated by the well developed regional network. The cooperation with regional partners plays therefore an important role for the realization of the different support programs.

Table 1: Overview on the Entrepreneurial Support Measures at the Universities in Hannover and Göttingen

		University in Hannover	University in Göttingen
Support measures	Sensitization measures	(+) Start-up scouts within faculties	
	Information supply measures	(+) Regional network	(+) Regional network
	Capability supply measures	(+) Wide range of programs	(-) Only few qualification programs
		(+) Optional seminars on entrepreneurship related topics	(+) Optional seminars on entrepreneurship related topics
		(+) Regional network	(+) Regional network
Resource supply measures	(-) No conclusive curricular entrepreneurship education	(-) No conclusive curricular entrepreneurship education	
	(+) Use of university infrastructure possible	(+) Use of university infrastructure possible	
	(+) Regional network	(+) Regional network	
	(-) Least developed support measure	(-) Least developed support measure	
Infrastructural facilities	University incubator	(-) Infrastructural facilities underdeveloped	(-) Infrastructural facilities underdeveloped
	Technology Transfer Office		
	Entrepreneurship Office		
	Entrepreneurship Professorship		
	Venture Capital Funds		(-) Fund is inactive

Grey: Support measure/infrastructural facility exists at respective university.

White: Support measure/infrastructural facility does not exist at respective university.

(+) Particularly positive feature

(-) Particularly negative feature

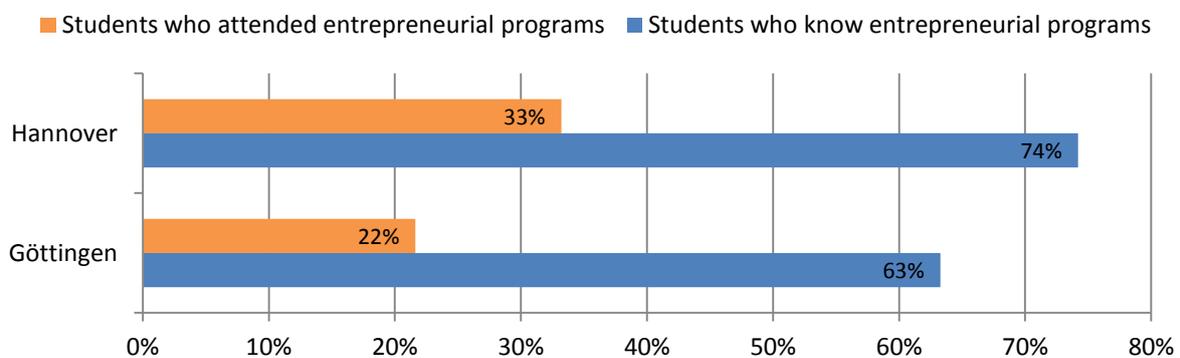
Source: Results of the interviews with key informants at the universities in Hannover and Göttingen 2011.

2.4.1.2 Students' Perceptions

As explained above, the entrepreneurial support measures at the universities in Hannover and Göttingen are well developed. However, the best support measures are worthless if they are not perceived by the students. Thus, within the framework of GUESSS the students were asked, which entrepreneurial programs they are aware of at their university and if they have ever attended at these programs. The categories of entrepreneurial programs in the GUESSS comprise entrepreneurial lectures and seminars on entrepreneurship in general, business

planning, innovation and idea generation, financing entrepreneurial ventures, technology entrepreneurship, entrepreneurial marketing, social entrepreneurship or family firms as well as entrepreneurial networks and coachings including workshops and networking with experienced entrepreneurs, a contact point for entrepreneurial issues, business plan contests and workshops, mentoring and coaching programs for entrepreneurs and contact platforms with potential investors. For the sake of clarity, the entrepreneurial programs are aggregated in the following figures.

When comparing the total awareness of and participation in the entrepreneurial programs at the universities it becomes clear that Hannover performs slightly but significantly better than Göttingen (see Figure 9). At the university in Hannover three quarters of the students know about the entrepreneurial programs and one third of the students have attended at least in one of the entrepreneurial programs. At the university in Göttingen the shares are lower: only 63 % of the students have heard about the entrepreneurial programs and 22 % have taken part. Obviously, the advertisement of the entrepreneurial programs at the university in Hannover is better than in Göttingen. However, if only the awareness of each single entrepreneurial program at the two universities is selected, Göttingen and Hannover remain below the German average (BERGMANN/CESINGER/OSTERTAG 2012).



Valid cases: 1,563 GAUG students, 1,581 LUH students. The percentage refers to the total number of students at the respective university.

Chi²-Tests: The differences between Hannover and Göttingen are significant among students who know entrepreneurial programs (p=0.000) as well as among students who attended entrepreneurial programs (p=0.000).

Source: Own calculations based on GUESSS 2011.

Figure 9: Awareness of and Participation in Entrepreneurial Programs

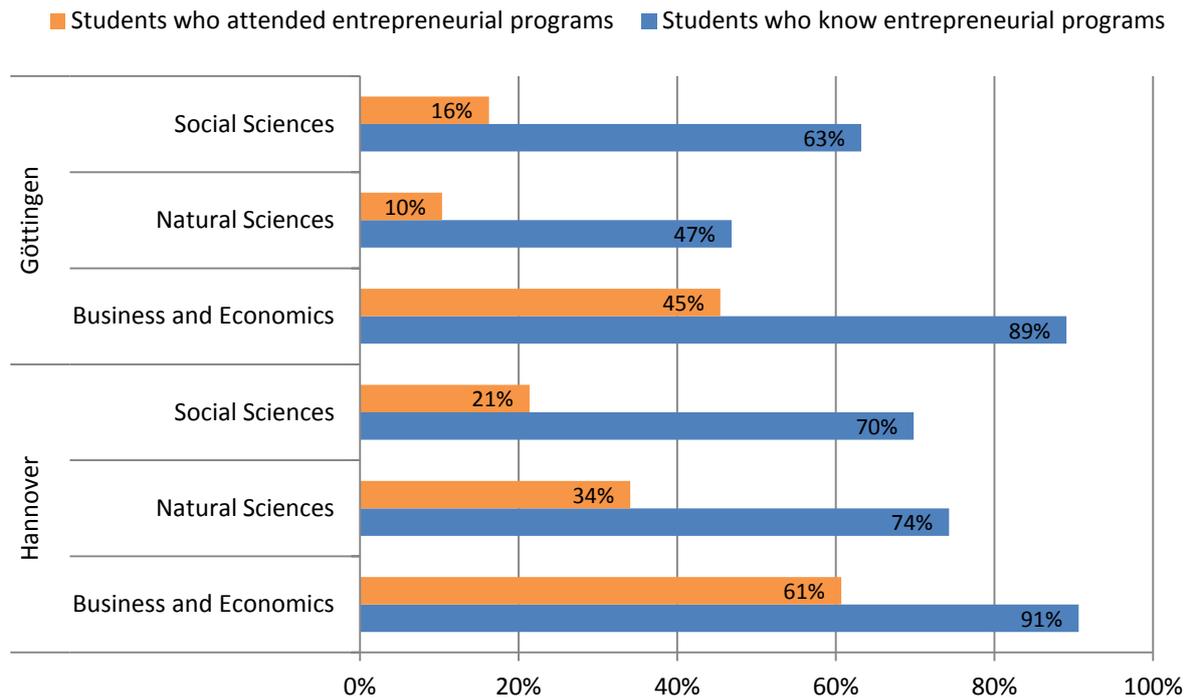
In the following analyses not only the two universities are compared but the results are also distinguished for three different fields of studies (social sciences, business and economics, natural sciences) and three forms of entrepreneurial intentions (students without entrepreneurial intention, students with entrepreneurial intentions and active founders). The

reason for this is that a correlation is expected between the students' perceptions of the entrepreneurial climate and their field of study or entrepreneurial intention, as already explained in the Chapters 2.2 and 2.3.3.

Figure 10 therefore shows the awareness of and participation in entrepreneurial programs at the two universities distinguishing between three different fields of studies: social sciences, natural sciences as well as business and economics. A closer look at the different fields of studies reveals large disparities. As it is to be expected, the business and economics students are best informed in the entrepreneurial programs at both universities. Their curriculum comprises lectures and seminars on entrepreneurship, at least as an optional subject. This is why the vast majority of around 90 % of the business and economics students know about the entrepreneurial programs at university. However, the share of students who then took part in one of these programs is substantially lower with 45 % in Göttingen and 61 % in Hannover. This difference is statistically significant.

For the other two fields of studies the situation is different. In Hannover the social science students know and use the programs the least. The disparity between knowing (70 %) and attending (21 %) is also highest. In the field of natural sciences three quarters of the students have heard about the programs, while one third have used them. In contrast, in Göttingen the field of natural sciences scores rather poorly. Only the half of the students knows about the entrepreneurial programs and only one in ten has attended. Although the field of social sciences performs slightly better, the result can be improved. 63 % of the social sciences students know about the programs but only 16 % have made use of them. Here the disparity between knowing and attending is remarkably high.

The results indicate that there is further upward potential at both universities for raising the awareness of and participation in the entrepreneurial programs. At the university in Göttingen improvements are required in the fields of natural and social sciences. Especially natural science students, which include in this case medicine, have naturally a high entrepreneurial potential, so that a better perception of the entrepreneurial programs may have a significant impact on the entrepreneurial activity at the university. While the university in Hannover fares better overall, it does still have upward potential in the fields of social sciences.



Valid cases: 117 business and economics students, 824 natural sciences students and 285 social science students at the LUH; 220 business and economics students, 559 natural sciences students and 375 social science students at the GAUG. The percentage refers to the number of students in the respective field of study.

Chi²-Tests: The difference between Hannover and Göttingen regarding students who know entrepreneurial programs is not significant among business and economics students ($p=0.712$) but significant among social science students ($p=0.082$) and natural science students ($p=0.000$). The difference between Hannover and Göttingen regarding students who attended entrepreneurial programs is not significant among social science students ($p=0.092$) but significant among natural science students ($p=0.000$) and business and economics students ($p=0.009$).

Source: Own calculations based on GUESSS 2011.

Figure 10: Awareness of and Participation in Entrepreneurial Programs according to Fields of Study and Universities

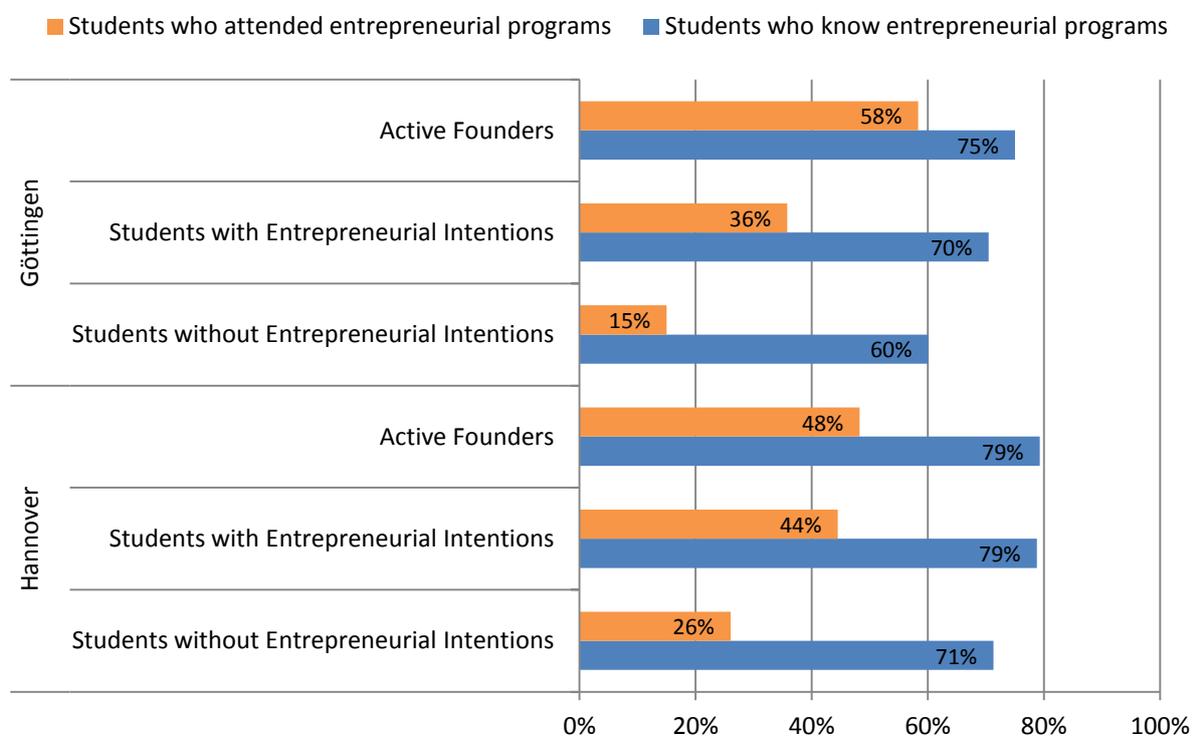
A correlation is also expected to exist between the students' perceptions of the entrepreneurial programs and their entrepreneurial intentions. Students who are not interested in the topic of entrepreneurship may not pay much attention to these programs. Therefore, Figure 11 shows the awareness of and participation in entrepreneurial programs distinguishing students' entrepreneurial intentions: students without entrepreneurial intentions, students with entrepreneurial intentions and students who are already involved in starting up a business.

Principally, it can be concluded that the share of students knowing or attending entrepreneurial programs increases with rising entrepreneurial intention. However, there is a small exception for the university in Hannover. Here, the share of students with entrepreneurial intentions knowing about the entrepreneurial programs is same as that of active founders (79 %).

Furthermore, the variance of the share of students knowing is not as large as the variance of the share of students attending the entrepreneurial programs. At the university in Hannover

the share of students knowing the programs is between 71 % and 79 %. At the university in Göttingen the share lies between 60 % and 75 %. The share of students attending the entrepreneurial programs increases with rising entrepreneurial intention from 15 % to 58 % at the university in Göttingen and 26 % to 48 % at the university in Hannover.

Also, the gap between the awareness and participation becomes smaller with increasing entrepreneurial intention. In the case of Göttingen, 60 % of the students without entrepreneurial intentions know about the programs while only 15 % take part in such programs. In utmost contrast, 75 % of the active founders are aware of the programs while 58 % make use of them. The pattern is similar but weaker for the university in Hannover.



Valid cases: 972 students without entrepreneurial intention, 580 students with entrepreneurial intentions and 29 active founders at the LUH; 1,092 students without entrepreneurial intention, 447 students with entrepreneurial intentions and 24 active founders at the GAUG. The percentage refers to the number of students with the respective entrepreneurial intention. Chi²-Tests: The difference between Hannover and Göttingen regarding students who know entrepreneurial programs is not significant among active founders (p=0.709) but significant among students with entrepreneurial intentions (p=0.002) and students without entrepreneurial intentions (p=0.000). The difference between Hannover and Göttingen regarding students who attended entrepreneurial programs is not significant among active founders (p=0.465) but significant among students with entrepreneurial intentions (p=0.005) and students without entrepreneurial intentions (p=0.000). Source: Own calculations based on GUESSS 2011.

Figure 11: Awareness of and Participation in Entrepreneurial Programs according to Students' Entrepreneurial Intentions and Universities

In summary, the total awareness of and participation in the entrepreneurial programs is quite satisfactory at the university in Hannover. The situation at the university in Göttingen is slightly but significantly less favorable. However, it is important to bear in mind that although

the entrepreneurial measures and infrastructural facilities normally focus on the business and economics as well as MINT subjects (e.g. the results of the accompanying research of EXIST III by KULICKE/DORNBUSCH/SCHLEINKOFER 2011), the business and economics students are the ones who raise the average. This is especially true for the university in Göttingen. Furthermore, it can be summarized that students with a higher entrepreneurial intentions are more interested in the entrepreneurial programs.

In the long term the universities should aim to obtain the awareness of all students. Each student should be aware of the entrepreneurial programs and should be aware that self-employment is an equal alternative to dependent employment, whatever the student's career choice is at the end.

2.4.2 Universities' General Policies on Spin-off Formation

As mentioned in Chapter 2.2, a university's climate regarding entrepreneurship as well as its entrepreneurship support measures and associated infrastructural elements can only be developed and can only function effectively when they are backed by a university's general policies on spin-off formation. These include both the general commitment of the university to the commercialization of university knowledge and technology via spin-off formation, as well as a set of specific rules, arrangements and unwritten norms that a university should establish in order to encourage its scientific staff and students to exploit intellectual property and engage in spin-off activities (ASTEBRO/BAZZAZIAN/BRAGUINSKY 2012; DI GREGORIO/SHANE 2003; FINI et al. 2011; SHANE 2004).

The interviews with key informants suggest that the general commitment of the university administration for the support of spin-off formation is rather inadequate at the universities in Hannover and Göttingen. In the case of Hannover however, the commitment supposedly had improved in the years before 2011. In this respect, the it increasingly acknowledges its role in regional development and the relevance of commercializing university technology and knowledge (key inf. 1, 2, 9). In fact, the topic was included to the mission statement of the university in Hannover: "*We support transfer of technology, start-ups and continuing academic education.*" (LEIBNIZ UNIVERSITÄT HANNOVER 2013a). In spite of this official commitment, the topic of spin-off formation still has little priority in comparison to other issues, such as assuring high quality research and teaching. In addition, other channels of knowledge and technology transfer (e.g. industry-cooperation or licensing) seem to be prioritized (key inf. 1, 2, 9).

The subordinate role of spin-off formation for the administration at the university in Hannover finds expression in the low commitment to concrete action and/or investments. In spite of the entrepreneurship office's staff's continuous efforts to convince the administration of the necessity to install an entrepreneurship professorship, a business incubator with office space on the campus and/or a university venture capital funds, none existed at the university in Hannover until the year 2011 (key inf. 2, 7, 9). The insufficient conclusiveness of the universities' spin-off concept as well as the underdeveloped entrepreneurship-related infrastructure (no entrepreneurship professorship, business incubator or venture capital funds) will also have long-term consequences: The federal support program funds (EXIST), which financed the start-up scouts within the four faculties, terminated in 2011, and the university's application for the follow-up program failed, mainly due to the illustrated shortcomings. Thus, it is questionable if and to what extent the intensive sensitization and mobilization efforts will be continued (key inf. 13).

Also at the university in Göttingen, knowledge and technology transfer supposedly plays an minor role for the university's administration compared to issues like assuring high quality education and research. One of the reasons for this is probably the university's successful application for the Excellence Initiative of the German Federal Ministry of Education and Research and the German Research Foundation in 2006/2007. The university was honored for its future concept in research. Because of the Excellence Initiative and a change in presidency the university put the focus on basic research and German Research Foundation (DFG) projects. Consequently, industrial projects, technology transfer and entrepreneurial support only play a minor role and receive little financial support by the university budget (e.g. the 0.5 full-time equivalent position at the entrepreneurship office) (key inf. 14, 15, 16, 20). Not surprisingly, in contrast to the university in Hannover, Göttingen's mission statement mentions its role in regional development and the commercializing university technology and knowledge only implicitly: *"Georg-August-Universität Göttingen perceives itself as a font of innovation to enrich all spheres of life, regarding it as its task [...] to publicise its research findings and promote their utilisation and to contribute to the responsible development of its regional environment."* (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2013a).

Regarding spin-off related rules, arrangements and unwritten norms, both universities established some general guidelines. In this respect, they officially allow academic entrepreneurs to use laboratory equipment and office space (key inf. 13). Furthermore, contractual arrangements for scientific staff starting-up a business (e.g. leave of absence or

part-time employment) are generally feasible. However, the concrete application of such procedures depends on the specific institute in which infrastructure is supposed to be used or in which the scientist is employed. While some institutes are very constructive in finding respective solutions, others are not inclined to allow the commercial use of their infrastructure and to find specific contractual arrangements (key inf. 2, 9, 13, 14, 20).

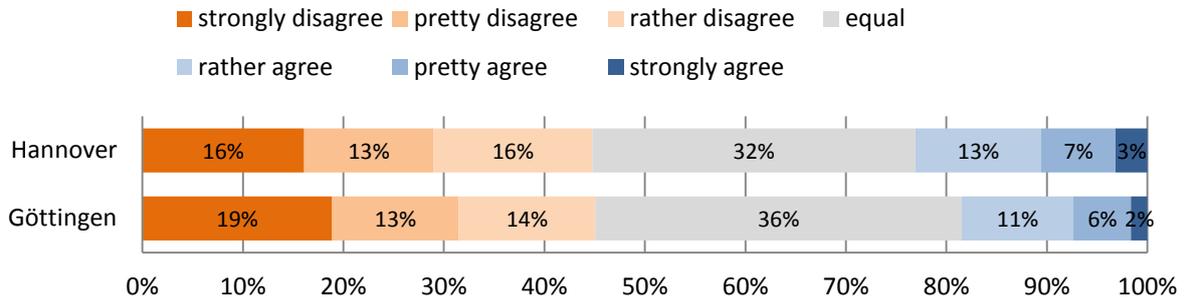
In summary, both universities acknowledge the topic of knowledge and technology transfer in their mission statements, at least implicitly in the case of Göttingen. However, the expert interviews suggest that when it comes to making the necessary investments the administrations' commitment is rather inadequate. Nevertheless, both universities established arrangements for the use of their infrastructure.

2.4.3 Students' Perception of the Entrepreneurial Climate

An important element for a capable entrepreneurial support structure at a university is the entrepreneurial climate as explained in Chapter 2.2. When students and faculty perceive a favorable entrepreneurial climate, they are more likely to develop and realize start-up ideas (GUERRERO/URBANO 2012; NDONZUAU/PIRNAY/SURLEMONT 2002; SHANE 2004; SIEGEL et al. 2003) and the start-up is more likely to perform successfully (GUPTA 2007).

In order to evaluate the entrepreneurial climate at the two universities, the students were asked how much they agree with the statement that there is a favorable climate and premises for becoming an entrepreneur at their university (see Figure 12). The results reveal that the students assess the entrepreneurial climate and premises quite similarly. About one fifth of the students at both universities agree with that statement, while one third is indifferent and about 45 % disagree. Beside this general tendency there is a slight difference between the universities in Hannover and Göttingen. Students at the university in Göttingen are more frequently indifferent or more inclined to disagree to the statement. The overall assessment of the entrepreneurial climate is therefore slightly but significantly better at the university in Hannover. However, in comparison to other German universities Hannover and Göttingen are both among the lowest ranked in regard to their entrepreneurial climate (BERGMANN/CESINGER/OSTERTAG 2012).

There is a favorable climate and premises for becoming an entrepreneur at my university.



Valid cases: 1,474 GAUG students, 1,485 LUH students.

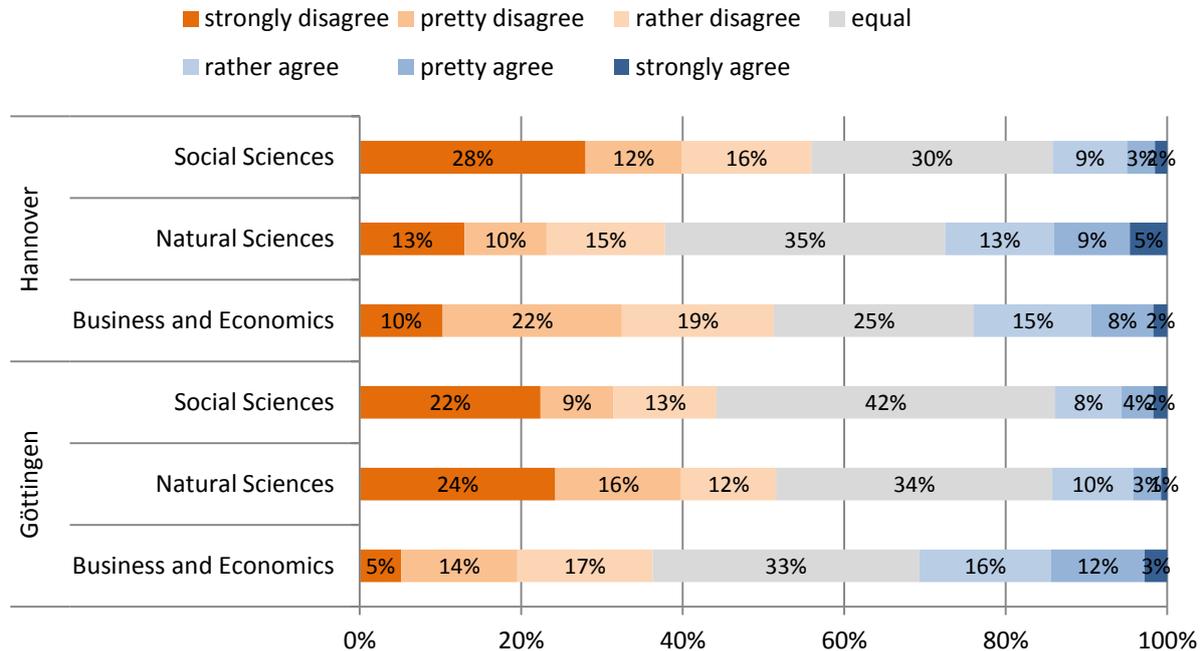
Chi²-Test: The difference between Hannover and Göttingen is significant (p=0.001).

Source: Own calculations based on GUESSS 2011.

Figure 12: Perception of the Entrepreneurial Climate

Due to the expected correlation between the students’ perceptions of the entrepreneurial climate and their field of study, Figure 13 distinguishes the entrepreneurial climate also between three different fields of studies: social sciences, natural sciences as well as business and economics. There are significant differences between the two universities regarding the fields of studies. At the university in Göttingen the entrepreneurial climate is evaluated the worst in the field of the natural sciences and best in the field of business and economics. In contrast, at the university in Hannover the natural science students evaluated the entrepreneurial climate best and the social science students worst. In summary, however, it can be concluded that the entrepreneurial climate at both universities and in all fields of studies can be improved. Even in those fields, where the students’ ratings are best, the shares of students, who are dissatisfied with the entrepreneurial climate, are still over 35 % at both universities. In contrast to this, only about 30 % of the students state that they are satisfied.

There is a favorable climate and premises for becoming an entrepreneur at my university.



Valid cases: 117 business and economics students, 778 natural sciences students and 261 social science students at the LUH; 215 business and economics students, 520 natural sciences students and 353 social science students at the GAUG.

Chi²-Tests: The difference between Hannover and Göttingen is significant among social science students (p=0.006), natural science students (p=0.000) and business and economics students (p=0.030). The perception of the entrepreneurial climate is aggregated in three categories for the Chi²-Test in order to avoid an expected frequency below five.

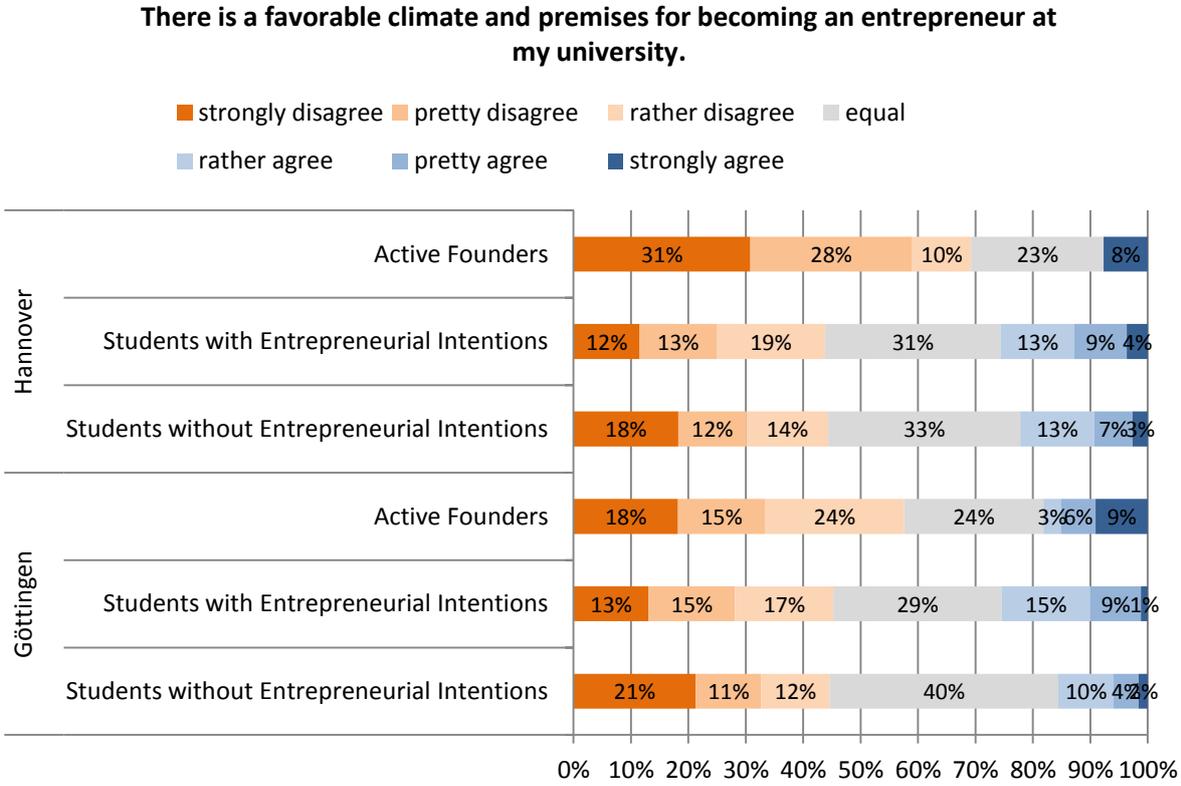
Source: Own calculations based on GUESSS 2011.

Figure 13: Perception of the Entrepreneurial Climate according to Fields of Study and Universities

A correlation between the students' perceptions of the entrepreneurial climate and their entrepreneurial intentions is also expected to exist. Students who are not interested in the topic of entrepreneurship may not pay much attention to the entrepreneurial climate. Therefore, Figure 14 shows the perception of the entrepreneurial climate distinguishing students' entrepreneurial intentions: students without entrepreneurial intentions, students with entrepreneurial intentions and students who are already involved in starting up a business.

It can be concluded that active founders evaluate the entrepreneurial climate at both universities worst, even if they are only a few in number. At the university in Göttingen almost 60 % of the active founders evaluate the entrepreneurial climate as rather unfavorable to strongly unfavorable. At the university in Hannover the share is even at almost 70 %. The marked difference between the students with and without entrepreneurial intentions is that students without entrepreneurial intentions evaluate the entrepreneurial climate more often as strongly unfavorable, have more often no opinion and find the entrepreneurial climate less often favorable. This is true for both universities, whereby the pattern is more distinctive for

the university in Göttingen. However, the share of students who find the entrepreneurial climate rather unfavorable to strongly unfavorable is for students with and without entrepreneurial intentions at both universities similar at a share of about 45 %.



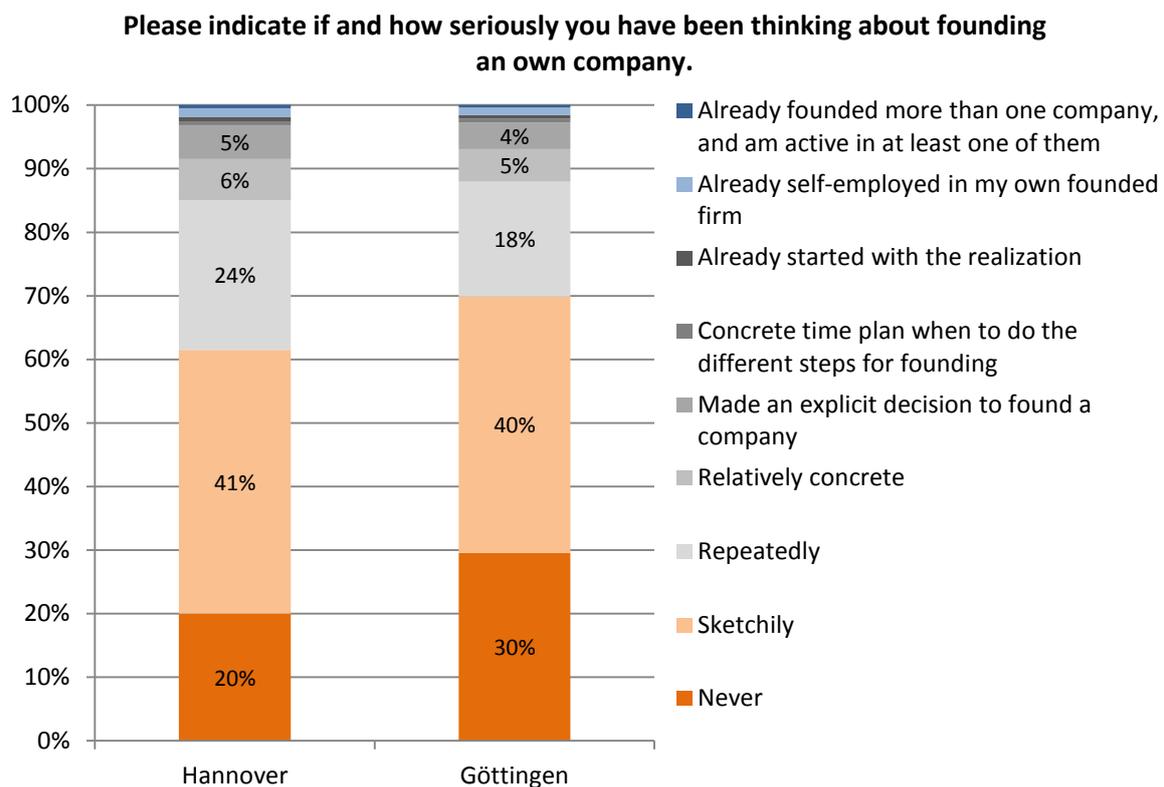
Valid cases: 972 students without entrepreneurial intention, 569 students with entrepreneurial intentions and 40 active founders at the LUH; 1,092 Students without entrepreneurial intention, 438 students with entrepreneurial intentions and 33 active founders at the GAUG.
 Chi²-Tests: The difference between Hannover and Göttingen is not significant among students with entrepreneurial intentions (0.218) but significant among students without entrepreneurial intentions (p=0.001). Chi²-Test not applicable for active founders because the expected frequency for six cells is below five.
 Source: Own calculations based on GUESSS 2011.

Figure 14: Perception of the Entrepreneurial Climate according to Students' Entrepreneurial Intentions and Universities

In summary, the results reveal that the entrepreneurial climate could be improved at both universities in all fields of studies. Even if different degrees of students' entrepreneurial intentions are considered, it does not explain the poor results. Nevertheless there are certain fields of studies, where the students evaluate the entrepreneurial climate even worse. At the university in Hannover it is in the field of social sciences and at the university in Göttingen it is in the field of natural sciences. Here, more than the half of students find the entrepreneurial climate rather unfavorable to strongly unfavorable.

2.4.4 Entrepreneurial Potentials among the Students

In order to evaluate to what extent entrepreneurial potential exists at the two universities the entrepreneurial intentions of the students were considered first (see Figure 15). The question is if and how seriously the students have been thinking about founding a company. The results indicate that there is a high entrepreneurial potential, which could be further mobilized.



Valid cases: 1,581 LUH students; 1,563 GAUG students. Students without entrepreneurial intentions colored orange, students with entrepreneurial intentions colored grey, active founders colored blue. The values not mentioned in the graphs are each < 1,5 %.

Chi²-Test: The difference between Hannover and Göttingen is significant (p=0.000).

Source: Own calculations based on GUESSS 2011.

Figure 15: Students' Entrepreneurial Intentions

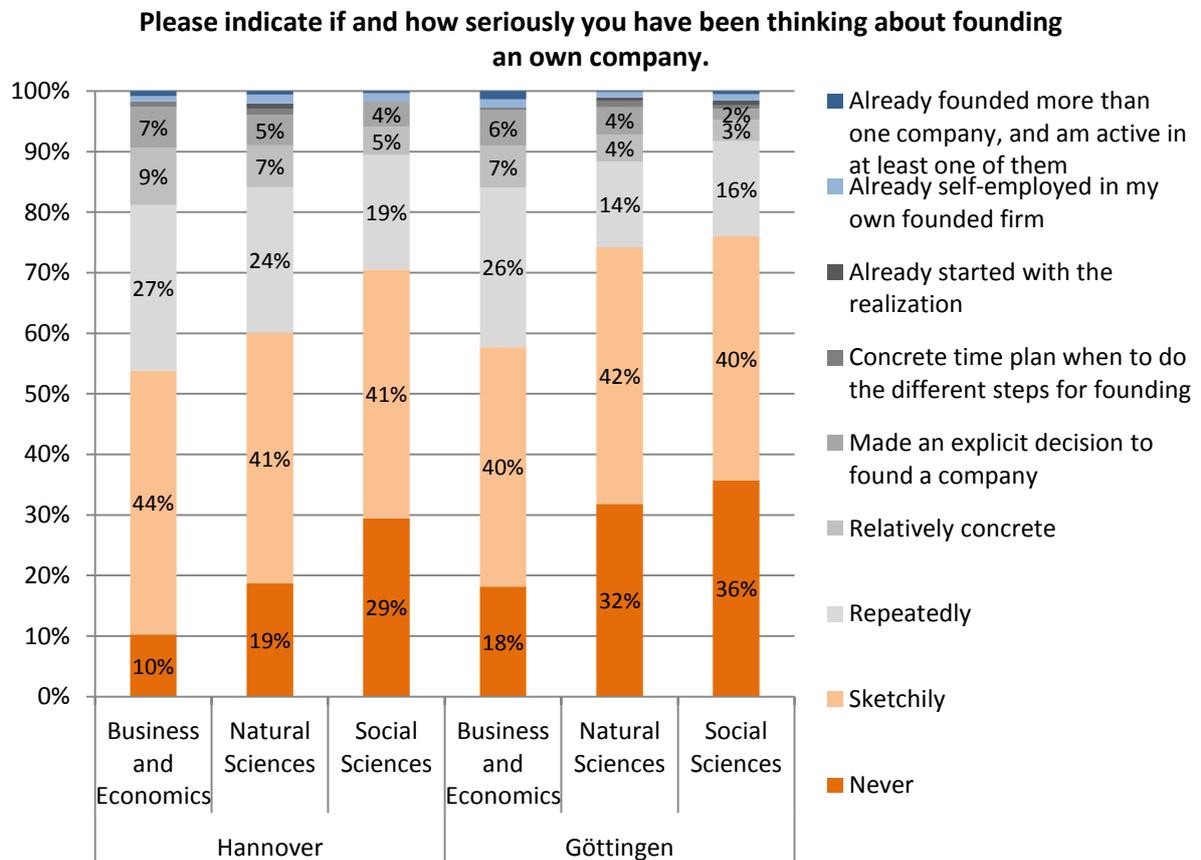
On the one hand, a large share of students has never or only sketchily thought about founding a company (colored orange). The share of these students, who have no entrepreneurial intention, is 70 % at the university in Göttingen and 60 % in Hannover. With this rate the university in Hannover corresponds roughly to the average of all German universities (55 %), while Göttingen is above average (BERGMANN/CESINGER/OSTERTAG 2012). The reason for the lack of entrepreneurial intention can be twofold. Some of these students may have already thought about being self-employed but came to the conclusion that owning a company is not an option for them. Other students may have never thought about being self-employed because they are not aware of self-employment as an equal alternative to dependent

employment. Especially the second group of students may therefore be susceptible to entrepreneurial sensitization measures. When taking into account only the students who have at least sketchily thought about founding a company (around 40 %) it is quite an indication for entrepreneurial potential. On the other hand there are many students at both universities (around 29 % in Göttingen and 37 % in Hannover) who have already repeatedly or even more concretely thought about founding a company (colored grey). These students with entrepreneurial intentions may profit from the entrepreneurial programs at the university, especially from information and capability supply measures. At the same time, only a very small minority of students of only 2 % at both universities is already involved in starting up a business (colored blue). For this group of students, capability and resource supply measures would be helpful.

In order to evaluate to what extent entrepreneurial potential exists within different fields of studies the question of how seriously the students have been thinking about founding a company is crossed with the three fields of subjects: business and economics, natural sciences and social sciences (see Figure 16). Regarding the three broad fields of studies, the share of students, who have never thought about starting up a business, is generally higher in the field of social sciences at both universities. Students of business and economics have the lowest share of individuals, who have never thought about founding a company and the largest share of individuals, who have thought about founding a company, at least sketchily to relatively concretely. This is, by definition, not surprising and fits with the dominant culture of the respective fields of studies. In the field of natural sciences the pattern of the students' entrepreneurial intentions differs between Hannover and Göttingen. In Göttingen the natural sciences students have similarly low entrepreneurial intentions as the social sciences students, while in Hannover the natural sciences students have on average higher entrepreneurial intentions. This may have different reasons. The university in Hannover offers technical study programs which are summarized in the field of natural sciences in this study. In national comparison the rate of technical science students at the university in Hannover with entrepreneurial intentions ranks among the top three (BERGMANN/CESINGER/OSTERTAG 2012). However, the university in Göttingen contains medicine, which is also predestinated for becoming self-employed.

In summary, the majority of students have at least sketchily thought about starting up a business. Therefore, the results indicate that a large entrepreneurial potential exists which is still unused and probably not yet well addressed by entrepreneurial support measures. The

biggest entrepreneurial potential is in the field of business and economics, although especially spin-offs of the so called MINT subjects are more promoted (KULICKE 2013), because they are based on technological innovations and fast growing.



Valid cases: 117 business and economics students, 824 natural sciences students and 285 social sciences students at the LUH; 220 business and economics students, 559 natural sciences students and 375 social sciences students at the GAUG. Students without entrepreneurial intentions colored orange, students with entrepreneurial intentions colored grey, active founders colored blue. The values not mentioned in the graphs are each < 1.5 %.

A Chi²-Test is not applicable because for some cells the expected frequency is below five even after aggregating the entrepreneurial intentions into three categories.

Source: Own calculations based on GUESSS 2011.

Figure 16: Students' Entrepreneurial Intentions according to University and Fields of Study

2.5 Conclusions

The aim of this paper was to compare the entrepreneurial support structure and entrepreneurial potential at the universities in Hannover and Göttingen. The universities' entrepreneurial support structures were characterized and compared with each other by the different elements identified in the conceptual framework. Overall, the empirical results suggest that the entrepreneurial support structure at both universities still have a considerable upward potential. The comparison of both universities shows that the entrepreneurial support structure is slightly better in Hannover.

The entrepreneurial support measures and infrastructural facilities can be characterized as follows. On the one hand the well developed entrepreneurial support measures are an asset of both universities and the majority of students is aware of them. Especially, at the university in Hannover the sensitization measures are well developed due in part to the start-up scouts in the natural science faculties. As a consequence, a higher share of students is aware of the entrepreneurial support measures. On the other hand the infrastructural facilities can be considered to be inadequate at both universities as there is neither an entrepreneurship professorship nor an incubator on either campus.

The universities' general policies on spin-off formation are rather impeding the dynamic of spin-off activities. Although both universities' mission statements mention the transfer of knowledge and technology via spin-off formation, at least implicitly in the case of Göttingen, their administrations' commitment is rather small when it comes to making financial investments. It is however positive that specific arrangements regarding for example the use of university infrastructure by academic entrepreneurs were established.

Another major inadequacy of the universities' entrepreneurial support structures is their insufficiently developed entrepreneurial climate. In fact, around 45 % of the students at both universities assess the entrepreneurial climate to be unfavorable for starting up a business. At both universities, this share is above the average of all German universities. For the fields of social sciences as well as business and economics in Hannover and natural sciences in Göttingen the results are even worse. In these fields more than the half of students finds the entrepreneurial climate to be unfavorable. Also, active founders at both universities evaluate the entrepreneurial climate to be particularly bad.

Although the students evaluate the entrepreneurial climate as rather unfavorable, there is entrepreneurial potential at both universities. The majority of students have at least sketchily thought about starting up a business. Business and economics students at both universities have the highest entrepreneurial potential. In view of the well-developed entrepreneurial support measures, the existing students' entrepreneurial potentials could at least partly be attributed to the previous efforts of the entrepreneurship offices. However, the result also indicates that there is still an upward entrepreneurial potential among the students which could be further mobilized.

2.5.1 Limitations and Further Research

Although the present empirical study gives an initial and comprehensive view on the entrepreneurial support structures at the universities in Hannover and Göttingen, some limitations and resulting need for further research should be considered.

In regard to survey methodology related issues, although many different key informants were consulted and the interview material was supplemented by archival material, the data collection by interviews with key informants could suffer from subjectivity. This especially applies to the quality of different support structure elements and infrastructural facilities, while the information on their existence and characteristics is probably less biased.

Regarding the quantitative student survey (GUESSS), a sampling bias cannot be excluded. Students who are interested in self-employment and entrepreneurship may be overrepresented as they are more prone to participate in such surveys.

Due to the fact that this study only includes data of the year 2011, the results are hardly transferable to other time periods. Furthermore, cross-sectional studies often have problems with endogeneity. Thus, the students' entrepreneurial intentions, for example, might influence their perception of the support structure and at the same time the support structure might influence the students' entrepreneurial intentions. In order to consider this aspect at least to a certain extent in this study, the students were differentiated regarding their entrepreneurial intentions in the calculations. In the future, a panel study could help to remedy this endogeneity problem. A first step in this direction could be projects such as the German National Educational Panel Study (NEPS) (SCHAEFER 2013).

As for content related issues, the following limitations must be considered. The focus of this paper is the entrepreneurial support structure at the universities. However, as the literature review as well as the results indicate, the regional context also plays an important role (GUPTA 2007; HEMER/SCHLEINKOFER/GÖTHNER 2007; LANDRY/AMARA/RHERRAD 2006; O'SHEA/CHUGH/ALLEN 2008; SHANE 2004). In this respect, a central aspect of a university's entrepreneurial support structure is its linkage to a regional network of different actors (e.g. economic development agencies, banks, consultants, etc.). Although such a network approach is considered to be an asset of both universities' entrepreneurial support structures, and different regional cooperation partners were mentioned in this respect, the scope of this investigation did not allow for an in-depth evaluation of their characteristics and qualities.

Furthermore, this investigation characterized the entrepreneurial support structure at an aggregated university level. However, recent studies also highlight the importance of the local work environment in connection with individual university spin-off activity (BERCOVITZ/FELDMAN 2008; DÖRRE/NEIS 2010; KENNEY/GOE 2004; NANDA/SORENSEN 2010; STUART/DING 2006). Therefore, there might be a difference in the entrepreneurial support structure between the different faculties and institutes of a university, especially regarding the entrepreneurial climate. In order to consider this aspect at least to a certain extent in this study, three broad fields of studies were differentiated. Further investigation of the micro work environment's influence could provide an interesting approach for further research.

2.5.2 Policy Implications

The entrepreneurial support measures at both universities are actually quite sufficient. Although the awareness among the students is satisfactory it could be improved, especially in the field of natural sciences at the university in Göttingen. The start-up scouts at the technical and natural science faculties in Hannover seem to have been a good approach, expressed by a comparatively better evaluated entrepreneurial climate and perception of the entrepreneurial programs. However, the business and economics students at both universities have the highest shares of awareness and participation regarding the entrepreneurial programs. Actually, the universities should aim to improve the awareness of every student - also in the fields of social sciences - that entrepreneurial programs are available and that self-employment can be an equally valid alternative to dependent employment. This vision is an ambitious target but the empirical results indicate that there still is a large entrepreneurial potential which can be mobilized and which is probably not yet well-addressed by entrepreneurial support measures. In this regard, it would be a great step forward if the infrastructural facilities could be improved as they currently are one of the weak links in the entrepreneurial support structures of both universities. An entrepreneurship professorship or an incubator on campus would positively influence the entrepreneurial climate as well as the perceptions of students and outsiders. To achieve this, however, it would be necessary that the universities' managements reconsider their priorities and increase their entrepreneurial commitment.

Acknowledgements

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3 Students' Career Attitudes - How Entrepreneurial Are Prospective Scientists?

Abstract

The aim of this paper is to find out how entrepreneurial prospective scientists are compared to prospective entrepreneurs. This study investigates the relationship between the intention of students to become scientists or entrepreneurs and their attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare. The study is based on quantitative data from the universities in Hannover and Göttingen which was collected in the context of the Global University Entrepreneurial Spirit Students' Survey. The results of the multinomial and binary logistic regression analyses surprisingly show that prospective scientists in fact are well equipped with attitudes which are conducive for starting a business. Prospective scientists and prospective entrepreneurs both find the realization of their dreams, independency and role models to be more important than other individuals. At the same time, both groups evaluate financial success to be less important than other individuals.

3.1 Introduction

One objective of many universities nowadays is to encourage university spin-off creation as part of a new "third mission" (ETZKOWITZ et al. 2000). One of the basic ideas behind this is that scientists can also become entrepreneurs. However, these scientists were once students, who made the decision to become scientists (and not entrepreneurs).

However, while the reasons for starting a business have already been extensively investigated in the past (e.g. CARTER et al. 2003; SCHEINBERG/MACMILLAN 1988; SHANE/KOLVEREID/WESTHEAD 1991; ZELLWEGER/SIEGER/HALTER 2011), we still know little about the motives for becoming a scientist, because these have been less researched especially in recent years (SAUERMAN/ROACH 2012). Despite intensive inquiry, a comparison between the career choice of becoming a scientist or an entrepreneur is to my best knowledge absent from scientific analyses.

Traditionally, most universities hire young scientists primarily with respect to their scientific capabilities. Yet, the young scientists that a university hires today might be those scientists that start a business tomorrow. Thus, if universities want their research staff to start up more

companies, they need to decide whether they should select young scientists not only on scientific grounds but also with respect to their entrepreneurial attitudes. This, in turn, raises questions regarding the differences in entrepreneurial attitudes between individuals that are interested in a career in academia (prospective scientists) and individuals that are interested in starting a business (prospective entrepreneurs). The question is in other words, how entrepreneurial are prospective scientists?

If prospective scientists have pretty much the same entrepreneurial attitudes as prospective entrepreneurs, universities do not need to care whether they should select young scientists not only on scientific grounds but also with respect to their entrepreneurial attitudes. However, if prospective scientists substantially differ in their entrepreneurial attitudes from prospective entrepreneurs, and thus are more similar to individuals seeking dependent employment, it is rather unlikely that they will start a business later on. In this case, universities might either need to try to positively influence the entrepreneurial attitudes of their employees or hire graduates that already have these attitudes.

The aim of this paper is to investigate the relationship between students' career choice intentions, differentiating between academia and entrepreneurship, and their entrepreneurial attitudes, meaning their attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare.

The empirical analysis is based on data collected within the context of the Global University Entrepreneurial Spirit Students' Survey (GUESSS). In this paper the focus is on quantitative survey data from the universities in Göttingen and Hannover, which are the two biggest universities in Lower Saxony measured by the number of students. Over 3,000 Bachelor, Master and PhD students were asked about their career plans and entrepreneurial attitudes. In order to compare the entrepreneurial attitudes of prospective scientists and entrepreneurs with each other as well as with other students, I conducted binary and multinomial logistic regression analyses.

This paper is structured as followed: First, I conduct a literature review from which I identify the career attitudes of scientists and entrepreneurs and derive two main hypotheses. Then, after describing the data and methods, I present and discuss the results of the multinomial and binary logistic regression analyses. Finally, I conclude with a summary, policy implications and indications for further research.

3.2 Literature Review on Career Attitudes

There are a number of theories dealing with career choice intentions, which originate from the fields of sociology and psychology. Examples are the theory of social learning (BANDURA 1977b), the entrepreneurial event theory (SHAPERO/SOKOL 1982), the self-efficacy theory (see BANDURA 1977a), the social cognitive career theory (LENT et al. 2002) and the theory of planned behavior (AJZEN 1991). All these theories argue that motivational elements determine an individual's intention for engaging in a specific behavior (HAASE/LAUTENSCHLÄGER 2011). AJZEN (1991) suggests in turn that the best predictor for a specific behavior is the intention. This study focuses on attitudes which influence career choice intentions.

The career choices of entrepreneurship and academia are of special interest because scientists and entrepreneurs have in principle two opposing value systems (SZYPERSKI/KLANDT 1981). These opposing value systems are reflected in the scientists' and entrepreneurs' attitudes and behaviors (JAIN/GEORGE/MALTARICH 2009). Thus, one would normally assume that prospective entrepreneurs and scientists differ greatly from one another in respect to their career attitudes. In the following, I conduct a literature review on the career attitudes of entrepreneurs and scientists and investigate how entrepreneurs and scientists differ, especially in regards to career attitudes that are considered to be entrepreneurial.

3.2.1 Career Attitudes of Entrepreneurs

Many studies on entrepreneurial career attitudes exist (e.g. CARTER et al. 2003; SCHEINBERG/MACMILLAN 1988; SHANE/KOLVEREID/WESTHEAD 1991). An empirically based theory on career choice motives was derived from studies of the Society of Associated Researchers of International Entrepreneurship (SARIE) (SCHEINBERG/MACMILLAN 1988). These studies were developed in the 80's and 90's by several authors, whereby SCHEINBERG was in the core of the field (see CARTER et al. 2003). SCHEINBERG and MACMILLAN (1988) developed the groundwork and came to the result that the need for approval, perceived instrumentality of wealth, communitarianism and the need for personal development, independence and escape were important factors. Based on these studies, BIRLEY and WESTHEAD (1994) develop founder types. They also identify motives such as the need for approval, independence and personal development as well as welfare considerations (in terms of contributing to the community), perceived instrumentality of wealth, tax reduction, and the following of role models to be important for founders. In more recent years, CARTER et al. (2003) give a broad overview on prior research on the reasons for getting into business. They

investigate the career motives of nascent entrepreneurs and developed five categories of reasons based on a literature review: innovation, independence, recognition, role models and financial success. Based on the literature presented above, I categorize entrepreneurial career attitudes into seven motivational groups: self-realization, status, independence, innovation, role models, financial success and contribution to society. In the following, I discuss each career attitude and derive the hypotheses at the end of this chapter.

The first entrepreneurial career attitude is self-realization. The category of self-realization describes an individual's desire to pursue self-directed goals, to realize one's dreams or visions and to challenge oneself (CARTER et al. 2003). Entrepreneurship is a very common path to self-realization which is an empirically developed career attitude and positively associated with the entrepreneurial choice (CARTER et al. 2003; CASSAR 2007; SCHEINBERG/MACMILLAN 1988). Furthermore, CASSAR (2007) reveals in his longitudinal study on entrepreneurial career reasons that especially the desire for self-realization underlies a recall bias and is thus underestimated in retrospective studies. This is a prospective study. It can therefore be supposed that the desire for self-realization has a strong influence on an entrepreneurial choice.

The second entrepreneurial career attitude is recognition. The category of recognition describes *"an individual's desire to have status and approval from one's family, friends, and from those in the community"* (CARTER et al. 2003:14). An individual's need for achievement seems to positively influence the entrepreneurial choice (MCCLELLAND 1965; SHANE/KOLVEREID/WESTHEAD 1991). Compared to the general population, the desire for recognition seems to be higher for classical entrepreneurs in a strict sense but not for small business owners (STEWART JR et al. 1999). Furthermore, an entrepreneur's desire for recognition, especially because of a higher status, seems to correlate with the business performance (CASSAR 2007; MCCLELLAND 1965; STEWART JR et al. 1999).

The third entrepreneurial career attitude is independence. The category of independence comprises *"an individual's desire for freedom, control, and flexibility in the use of one's time"* (CARTER et al. 2003:14). Independence is an empirically developed career attitude which is positively associated with the entrepreneurial choice (CASSAR 2007; DOUGLAS/SHEPHERD 2002; KOLVEREID 1992). It is even considered to be one of the most important career attitudes for nascent entrepreneurs (CASSAR 2007) and therefore more important for the choice between self-employment and dependent employment (BIRD 1989; DOUGLAS/SHEPHERD 2002; KATZ 1994). A study by the Federal Ministry of Education and

Research in Germany also reveals that the workplace flexibility as well as being one's own boss are the most important motives for students to become self-employed (JOSTEN et al. 2008).

The fourth entrepreneurial career attitude is innovation. The category of innovation comprises an individual's intention to create something new (CARTER et al. 2003) or doing something different (AMIT et al. 2001). Entrepreneurship and innovation are strongly linked processes (SCHUMPETER 2000). Especially SCHUMPETER described the entrepreneur as also being an innovator (HÉBERT/LINK 2006). Usually entrepreneurs want to generate new ideas in order to put them into practice. This might be especially true for high technology entrepreneurs (AMIT et al. 2001). AMIT et al. (2001) for example came to the result that the desire for innovation was the most important decision incentive for entrepreneurs and it was significantly more important for entrepreneurs than for non-entrepreneurs.

The fifth entrepreneurial career attitude is role models. The theories of role identification and social learning generally explain the phenomenon of role models (GIBSON 2003; GIBSON 2004). The category of role models comprises "*an individual's desire to follow family traditions or emulate the example of others*" (CARTER et al. 2003:14). It has been empirically proven that role models have an influence on an individual's career decisions (BOSMA et al. 2011). Especially in the literature on entrepreneurship the issue of role models has been quite popular and widely discussed (BOSMA et al. 2011; DUBINI 1989). Empirical studies show that entrepreneurial role models are often found in the family background (ALDRICH/KIM 2007; SHAPERO/SOKOL 1982).

The sixth entrepreneurial career attitude derived from the literature is social welfare. The category of social welfare is rooted in the concept of collectivism (HOFSTEDE 1984) and communitarianism (ETZIONI 1995). Starting a business can be one way to contribute to the welfare of a community, people with the same background or family (DUBINI 1989), which is why it has been used as an entrepreneurial career attitude in prior empirical studies (BIRLEY/WESTHEAD 1994; SCHEINBERG/MACMILLAN 1988). Social entrepreneurship as a practice has already existed for a long time. Famous social entrepreneurs are Muhammad Yunus who established the Grameen Bank in 1976 and Bill Drayton who founded Ashoka in 1980, to give only two examples (MAIR/MARTÍ 2006). In the emerging field of social entrepreneurship, the career attitude of social welfare has recently received more attention (SCHEUERLE et al. 2013).

Finally, the seventh entrepreneurial career attitude is financial success. The category of financial success comprises “*an individual’s intention to earn more money and achieve financial security*” (CARTER et al. 2003:14). Although financial success is an empirically developed career attitude which is strongly associated with the entrepreneurial choice (CASSAR 2007), money does not seem to be the most important reason for starting a business. AMIT et al. (2001) for example came to the result that wealth is significantly less important for entrepreneurs than an aggregate of other motives, and that entrepreneurs also do not find wealth more important than non-entrepreneurs. The desire for a higher income are rather strongly connected with the intention of becoming an employee (HAASE/LAUTENSCHLÄGER 2011). Especially larger companies provide better possibilities for a secure career and to earn higher wages compared to being self-employed, at least in the medium term (PEEL/INKSON 2004). For that reason, it can be supposed that the desire for financial success does not positively influence an entrepreneurial intention.

3.2.2 Career Attitudes of Scientists

In utmost contrast to entrepreneurs, scientists usually work in an environment without economic constraints (STEPHAN/LEVIN 1996). Due to the socialization process at the university (DING/CHOI 2011; JAIN/GEORGE/MALTARICH 2009; MERTON 1973), the current opinion is that scientists have hardly any entrepreneurial attitude (MANGEMATIN 2000). In contrast to entrepreneurial attitudes, motives for becoming a scientist have been less researched systematically (SAUERMAN/ROACH 2012). However, the classical motives for becoming a scientist are expressed as “*ribbon, puzzle and gold*” (HAGSTROM 1975; MERTON 1973; STEPHAN/LEVIN 1992) or as a “*taste for science*” (ROACH/SAUERMAN 2010). Both are in contrast to the “*taste for business*” (PELLENS 2012) which entails a salary, job security and career progress. In the following, the seven entrepreneurial career attitudes described above are applied to the career choice of scientists from a theoretical perspective. I investigate whether the literature on science research provides information on to what extent scientists may also have entrepreneurial attitudes.

The term “*ribbon*” refers to recognition through publication, citation, peers and membership in honorary academies. It is probably the most important reward for scientists because it determines other secondary compensations such as research funding and salaries (MERTON 1957). WENTLAND, KNIE and SIMON (2011) reveal that German scientists improve their reputation mainly by publishing in peer-reviewed journals and secondly through teaching, whereas patenting, technology transfer and entrepreneurial activity are less important.

PELLENS (2012) as well as ROACH and SAUERMAN (2010) also state that scientists are mainly interested in upstream research but not so much in the commercialization of knowledge. Nevertheless, scientists have the desire for innovation by creating something new and having a technological success (STEPHAN/LEVIN 1992, 1996). This persistent desire for intellectual challenge and learning can also be understood as a kind of self-realization, which is related with the term “puzzle” (HAGSTROM 1975; STEPHAN/LEVIN 1992). Furthermore, scientists want to have the freedom to choose research projects depending on their interests (ROACH/SAUERMAN 2010). The university environment is far apart from economic constraints and gives scientists the opportunity to pursue independent research (STEPHAN/LEVIN 1996). It can therefore be assumed that scientists have not only a desire for recognition, innovation and self-realization but also for independence (ROACH/SAUERMAN 2010).

Conducting research is also a way to contribute to social welfare (PELLENS 2012). According to the scientific norm of communalism, new knowledge is the result of a collective effort, and no single claim of ownership should exist (MERTON 1957, 1973). A single researcher’s new findings are always built to a great extent on the knowledge of other researchers who previously made their results available to the research community. For this reason, researchers should always communicate their new insights. Only a collective process will lead to social development. The academic norms should therefore ideally emphasize openness and sharing (ROACH/SAUERMAN 2010). An important recent trend in this regard is the open access movement, which makes research articles freely available on the Internet (ANTELMAN 2004).

The term “gold” stands for financial success in regards to salary and job security. However, financial success usually plays only a minor role for scientists (LAM 2010; PELLENS 2012), although recent studies argue that the reward system of scientists changed from “traditionalism” to “commercialism” especially in the USA since the Bayh–Dole Act was established (JOHNSON 2011). In Germany the commercialization of knowledge is not as common and recognized yet (DÖRRE/NEIS 2010). Furthermore, many university scientists have fixed-term contracts financed by external funding (ROACH/SAUERMAN 2010). Then, after habilitation it is very difficult to find a professorship. Due to the insecure employment status and comparatively small salary at a university, apart from receiving a full professorship, it can be assumed that financial success is not important for prospective scientists (BRIEDIS et al. 2013; JAKSZTAT/SCHINDLER/BRIEDIS 2010).

As role models generally have an influence on an individual's career decisions (BOSMA et al. 2011), it is quite conceivable that scientists are also confronted with role models. Although empirical studies in this field seem to be missing, SAUERMAN and ROACH (2012) state that advisors encourage their PhD students to follow a research career. This might be an indication that scientists also like to follow role models.

3.2.3 Summary of the Hypotheses

Although one would normally assume that prospective entrepreneurs and scientists differ greatly from another according to their career attitudes, the literature review indicates that entrepreneurs and scientists might surprisingly be more similar in regards to their entrepreneurial career attitudes than generally supposed. Referring to the literature presented above, I derive following hypotheses:

1. Prospective entrepreneurs and prospective scientists have a higher desire for self-realization (A), recognition (B), independence (C), innovation (D), role models (E), social welfare (F) and a lower desire for financial success (G) compared to other individuals.

A direct comparison of the attitudes of scientists and entrepreneurs is still absent from literature. However the literature review shows that scientists have similar career attitudes as entrepreneurs. Consequently, I assume that prospective scientists and entrepreneurs have the same entrepreneurial attitudes, not only in comparison to individuals with other career choice intentions but also in direct comparison to each other.

2. Prospective entrepreneurs and prospective scientists have the same desire for self-realization (A), recognition (B), independence (C), innovation (D), role models (E), social welfare (F) and financial success (G).

3.3 Data and Methods

In the empirical part of this paper, the above framework on career attitudes is used in order to investigate and analyze students' career choice intentions and to test the two hypotheses. A wide range of literature already exists on top universities and regions like Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (SAXENIAN 1983; STERNBERG 2010). The data used in this paper was collected in the context of a research project named "University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen" in collaboration with the

Global University Entrepreneurial Spirit Students' Survey (GUESSS).¹³ GUESSS is an international annual online survey, which evaluates the entrepreneurial competence and activity of Bachelor, Master and PhD students (BERGMANN/CESINGER/OSTERTAG 2012). For the current study, the data was collected in 2011 at the universities of Hannover and Göttingen. The chosen universities are the two biggest universities in Lower Saxony, Germany with regard to the total number of students¹⁴, the number of students in subjects which are common for university spin-offs¹⁵, the number of scientific staff, and research expenditures (KULICKE et al. 2008:76 f.). The universities have the same education policies because in Germany, education is regulated on Federal State level (BARTSCH 2009). The two universities are also particularly suitable examples of German universities located in regions without high-tech clusters. At this kind of university, the individual abilities of students play an especially important role for prospective career intentions, because only a weak entrepreneurial culture and support structure exist. A total number of 3,151 students were interviewed at the universities of Hannover and Göttingen, the greatest number of cases in the German GUESSS. The response rate for the university of Hannover was 7,9 % and for the university of Göttingen 6,5% in the survey year 2011 (BERGMANN/CESINGER/OSTERTAG 2012). Compared to other online surveys addressing students (e.g. JOSTEN et al. 2008), the response rate is quite satisfactory.

The statistical analysis is based on a binary and multinomial logistic regression. The binary logistic regression compares prospective scientists and entrepreneurs only. The multinomial regression compares prospective scientists and entrepreneurs with a reference group. The large group of prospective employees is taken as a reference.

The dependent variable is the career choice intention of the students five years after finishing their studies. The time lag of five years ensures that a long-term career choice intention is obtained. This way, students who only want to complete a PhD and then leave academia do not bias the results. Three broad occupational groups are differentiated: prospective scientists, entrepreneurs and employees. Prospective scientists are students who plan to be employed at a university or follow an academic career. The category of prospective entrepreneurs includes

¹³ See acknowledgements at the end of the chapter.

¹⁴ Leibniz Universität Hannover had 21,478 students and Georg-August-Universität Göttingen 26,381 students in the summer semester 2013 (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2013b; LEIBNIZ UNIVERSITÄT HANNOVER 2013b).

¹⁵ These are the MINT subjects (mathematics, computer science, natural science and engineering) and medical science (KULICKE et al. 2008). MINT subjects are comparable to the STEM fields used in English. These include science, technology, engineering and mathematics.

students who want to start up a (franchise) company or did it already, who want to be a freelancer or who plan the succession in or acquisition of an existing enterprise. The category of prospective employees comprises students who want to be dependently employed in a small, medium or large enterprise or in the public service sector. This last category is used as the reference group in the multinomial logistic regression analysis. For the binary logistic regression prospective employees are excluded from analysis and prospective scientists are used as the reference category for prospective entrepreneurs.

The independent variables are career attitudes, identified and categorized according to the literature review above. The students were asked the question: “How important are the following attitudes for your future career?”. The answers were assigned to a seven-point Likert scale (from 1 = “not important at all” to 7 = “very important”), while each rating point was not labeled with an individual descriptive. The seven career attitudes were operationalized by items following CARTER et al. (2003) and CASSAR (2007). “Self-realization” represents attitudes associated with the realization of one’s own dream. “Financial success” describes an individual’s intention to earn a larger personal income. “Role models” represents an individual’s desire to follow the example of a person one admires. “Innovation” describes an individual’s aspiration to be innovative and at the forefront of technology. “Recognition” represents an individual’s desire to achieve and get recognition from peer groups. Finally, “independence” describes an individual’s desire to be self-employed. Additionally to the items suggested by CARTER et al. (2003) and CASSAR (2007), the career attitude “welfare” is included in the analysis. “Welfare” describes an individual’s desire to follow a social mission. These instruments have also been used in other GUESSS studies (e.g. VIVIERS/VENTER/SOLOMON 2012; ZELLWEGER/SIEGER/HALTER 2011) and have been shown to be reliable as a measure of career attitudes.

Finally, I include a number of control variables, which are used in comparable surveys (ZELLWEGER/SIEGER/HALTER 2011). These are gender (female = 1, male = 0), nationality (foreign = 1, German = 0), family business background (yes = 1, no = 0) and university (Hannover = 1, Göttingen = 0). I exclude age, because the students in the sample are of the same age range. However, I include the level of studies with two dummies for Master and PhD students. For both dummies Bachelor students make up the reference category. Furthermore, I exclude the different fields of studies because of endogeneity. Individual attitudes influence what field of study students choose but the field of study can also have an effect on individual attitudes during the period of study.

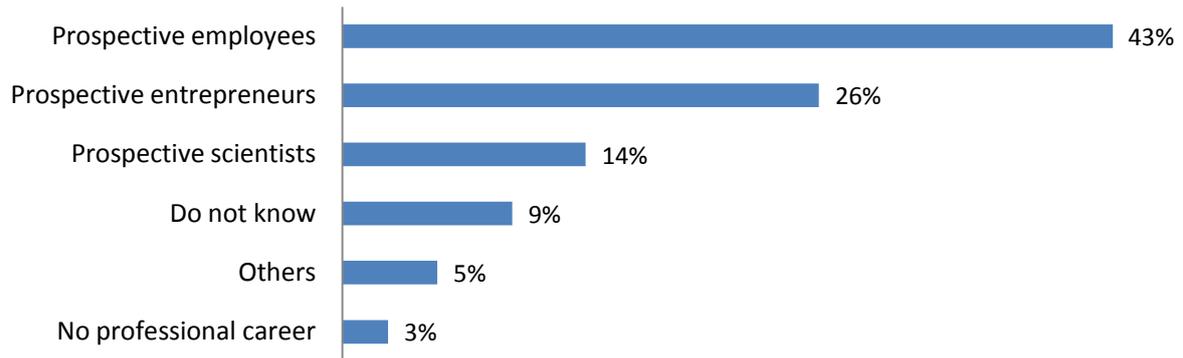
3.4 Results

In order to get an overview of the data, the data is first analyzed descriptively. Secondly, in order to verify the first hypothesis, a multinomial logistic regression analysis is conducted. In this analysis prospective entrepreneurs and prospective scientists are compared with the reference group of prospective employees. Thirdly, with regard to the second hypothesis prospective entrepreneurs and scientists are compared with each other by conducting a binary logistic regression analysis. For this calculation I only include students who plan to be either entrepreneurs or scientists five years after completion of their studies.

3.4.1 Descriptive Statistics

Figure 17 shows the students' career choice intentions five years after studies. The majority of students want to be dependently employed at a company or in public service. These students are defined as prospective employees. The second most common desired career is starting or taking over a business, defined as prospective entrepreneurs. One quarter of the students can imagine to be self-employed five years after studies. This number is quite high compared with the total early-stage entrepreneurial activity rate in Germany of about 5 % of the 25- to 30-year-olds (GLOBAL ENTREPRENEURSHIP MONITOR GERMANY 2011¹⁶). However, this result is in line with the students' survey "Female Academic Entrepreneurs" (FACE), which also achieved results that imply a high untapped entrepreneurial potential among German students (JOSTEN et al. 2008). The third most important career choice intention is having a career at a university or in academia, defined as prospective scientists. 14 % of the students can imagine following this career path. The remaining students still do not know which type of career they want to have, plan another career path or have no professional career plans. Each one of these intentions entails less than 10%, which is why students with these intentions are excluded from the multinomial regression analyses.

¹⁶ I would like to thank the members of the German Global Entrepreneurship Monitor team who have generously made the data available to me.

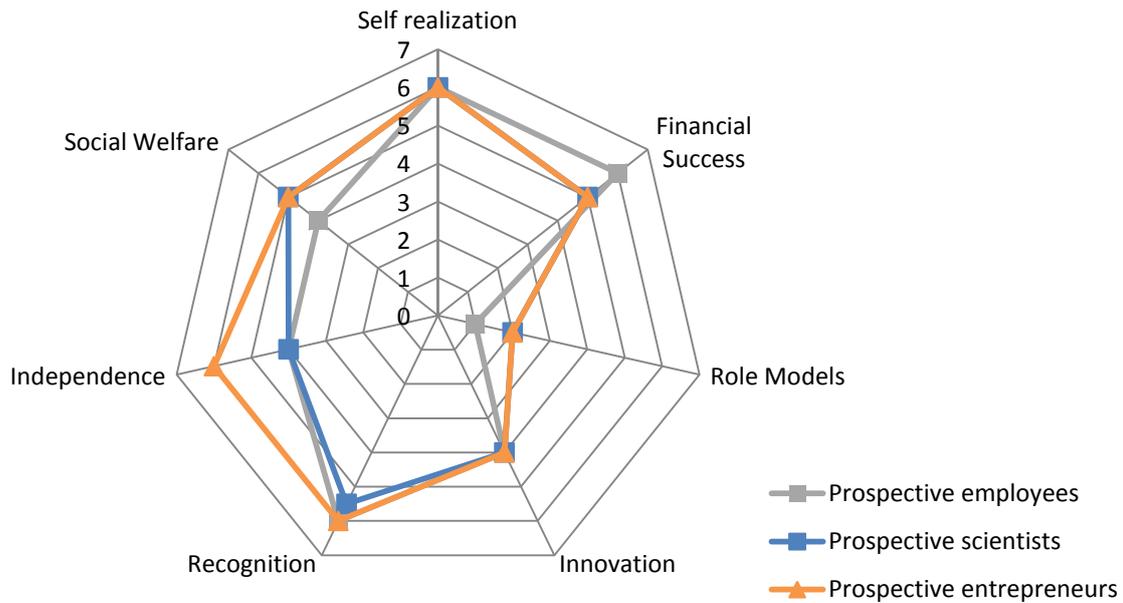


Note: Only students from the universities of Hannover and Göttingen are included.
 Source: Own calculation based on GUESSS 2011.

Figure 17: Students' Career Choice Intentions Five Years After Studies

Figure 18 shows the seven career attitudes differentiating students with the career choice intentions of becoming an employee, a scientist or an entrepreneur. According to the hypotheses derived on the basis of the literature review, prospective scientists and entrepreneurs are expected to consider all career attitudes to be comparatively important, except the desire for financial success. The descriptive results indicate that this seems to be only true for the desire for role models, social welfare and financial success. The career attitudes of self-realization, innovation and recognition seem to be similarly rated by all students, whereas self-realization and recognition are most important. The desire to follow a role model is more important for prospective entrepreneurs and scientists than for employees, but surprisingly less important than it might be expected from the literature review (BOSMA et al. 2011; DUBINI 1989). In total, prospective entrepreneurs and scientists seem to share the same attitudes. Only the desire for independence is obviously rated higher by prospective entrepreneurs.

Further descriptive statistics for all indicators of the career attitudes and the control variables can be found in Annex 1 including medians, minimum and maximum values as well as the number of cases.



Note: Median depicted from 1=very unimportant to 7=very important.
 Source: Own calculation based on GUESSS 2011.

Figure 18: Students' Career Attitudes

3.4.2 Results of the Regression Analyses

Firstly, in order to verify the first hypothesis I conduct a multinomial logistic regression (MLR) analysis. In this analysis, prospective entrepreneurs and prospective scientists are both compared with the reference group of prospective employees. This results in a total number of valid cases of 2,596 students in Model I and 2,548 students in Model II (see Table 1). Therefore, it is possible to compare a minority of students, who want to become scientists or entrepreneurs, with the majority of students who strive for employment in a company or in the public service.

Secondly, to verify the second hypothesis prospective entrepreneurs and scientists are compared with each other by conducting a binary logistic regression (BLR) analysis. For this calculation I only include students who either want to be entrepreneurs or scientists five years after their studies. This results in a total number of valid cases of 1,252 students in Model I and 1,230 students in Model II (see Table 2).

In both the binary and multinomial logistic regression analyses I only include the control variables in the first model. Overall, the results of the control variables are in line with my expectations. In both models, the control variables only explain a small part of the variance (BLR: 6.5 % and MLR: 5.1 %). In the second models, I include all seven career attitudes. The Pseudo-R²s increases considerably to 0.283 in the MLR (see Table 2) and to 0.224 in the BLR (see Table 3). This shows that career attitudes determine career choice intentions among

students to a great extent. Thus, career attitudes seem to be able to explain and accurately predict career choice intentions among different types of students.

The descriptive analysis showed that the all types of students evaluate the desire for self-realization as important for their career choice intention. However, if one controls for further determinants that may also influence the career choice intention, as it is the case in the multinomial regression, the probability of being a prospective scientist or entrepreneur and not a prospective employee is higher for students who evaluate the desire for self-realization as more important. According to the odds ratios in the multinomial logistic regression, self-realization has the second highest impact. Furthermore, the binary logistic regression shows that scientists and entrepreneurs do not significantly differ from each other in their desire for self-realization. Consequently, these results are in line with the hypotheses.

The desire for role models is also higher for prospective scientists and entrepreneurs compared to prospective employees, as the multinomial regression shows. The variable is significant for both groups. Furthermore, the binary logistic regression shows that scientists and entrepreneurs do not significantly differ in their desire for following an admirable person, which is also in line with my hypotheses - although the descriptive analysis showed that all students evaluate role models as relatively unimportant for their career choice. Also, according to the odds ratios in the logistic regressions, the desire for role models has only a low influence on the likelihood of becoming a prospective entrepreneur or scientist. Nevertheless, it is obvious that not only prospective entrepreneurs but also prospective scientists have a higher desire to follow role models than prospective employees, even if on a low level. To my best knowledge the issue of role models has not yet been addressed in scientific research and according to the current results it may deserve more attention.

The desire for independence is also higher for prospective scientists and entrepreneurs compared to prospective employees as the multinomial regression shows. So far, this result is in line with the first hypothesis. However, not only the descriptive analysis but also the odds ratios of the multinomial logistic regression analysis and the results of the binary logistic regression analysis show that independence is the most important predictor for prospective entrepreneurs and significantly less important for prospective scientists. The results indicate that although scientists conduct research independently, they are to some degree bound to directives and instructions of the university or research institution they are employed at. The degree of independence is higher for entrepreneurs, and the second hypothesis has to be discarded in regard to this aspect.

The desire for financial success is significantly less important for prospective scientists and entrepreneurs than for employees. This result is in line with the first hypothesis and the descriptive analysis. Although financial success is an empirically developed career attitude, which is strongly associated with the entrepreneurial choice (CASSAR 2007), money does not seem to be an important reason for starting up a business (AMIT et al. 2001). However, the comparison of prospective scientists and entrepreneurs only, reveals that prospective entrepreneurs still have a significantly higher desire for financial success. The lower desire for financial success is the most significant predictor for the likelihood to be a prospective scientist and not a prospective entrepreneur or employee. This means that, compared to all other groups, prospective scientists are barely motivated by financial incentives. Therefore, the second hypothesis also has to be rejected in regard to this aspect.

Prospective scientists and entrepreneurs do not significantly differ in their desire for innovation, neither in comparison to each other nor to prospective employees. This corresponds to the descriptive analysis. These results contradict the first hypothesis but still verify the second hypothesis. Also, some empirical studies indicate that the desire for innovation was insignificant for the entrepreneurial decision (e.g. CARTER et al. 2003). One explanation for the insignificant results may be that innovation does not primarily influence an initial entrepreneurial choice but rather the subsequent growth of a venture (CASSAR 2007). Another explanation could be that although there is no significant difference, it may be that prospective scientists, entrepreneurs and employees have different ideas on innovation and social welfare. While prospective scientists want to be innovative in their field of basic research, employees want to conduct applied research and prospective entrepreneurs rather wish to implement these ideas (SAUERMAN/ROACH 2012).

The descriptive analysis for the career attitude of social welfare indicates that prospective employees are less interested in following a social mission. However, if one controls for further determinants in the logistic regressions, it becomes clear that prospective scientists and entrepreneurs do not significantly differ in their desire for social welfare, neither from prospective employees nor from each other. In other words, the career attitude social welfare cannot be used to predict the career choice intentions of students. Accordingly, these results contradict the first hypothesis but still verify the second one. The reason for having the attitude of social welfare may be similar to the reason for having the career attitude of innovation. The possibility to contribute to social welfare occurs in different ways. It does not

seem to be related to a specific kind of occupation and can take place in the environments of entrepreneurship, academia and employment.

Surprisingly, receiving recognition is the least important for prospective entrepreneurs, while prospective scientists and dependent employees do not differ significantly in their desire for recognition. These results completely contradict both hypotheses, and also the previous descriptive analysis did not indicate such results. One possible explanation for the prospective entrepreneurs' low desire for recognition is that many different types of entrepreneurs exist. Empirical evidence indicates that an entrepreneur's need for achievement correlates with the company's performance. The correlation is higher for classical entrepreneurs in a strict sense but not for small business owners (STEWART JR et al. 1999). This suggests that only a more in-depth differentiation of the types of prospective entrepreneurs might lead to significant results. Another explanation could be that entrepreneurs need to assert their founding idea, even in spite of potential opposition. Therefore they might be less interested in the approval by third parties (CARTER et al. 2003).

In order to check whether the results are robust, I conducted statistical outlier tests using Cook's Distance (BACKHAUS/ERICHSON/PLINKE 2005). The values were below 0.2, therefore there are no influential outliers. Also, I tested for multicollinearity by calculating the Spearman's rank correlation coefficients and the variance inflation factor (VIF) for all independent variables used in the logistic regressions (BACKHAUS/ERICHSON/PLINKE 2005). The Spearman's rank correlation coefficients were all below 0.4 (see Annex 2). The VIF values were below 1.5. These results prove that the models are not influenced in any significant or systematic way.

Table 2: The Prediction of Becoming a Prospective Entrepreneur or Prospective Scientist - Results of the Multinomial Logistic Regression Analysis

Career choice intentions: five years after studies		Model I				Model II			
		B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp(B)
Prospective Scientists	Constant term	-1.047	77.531	.000		-1.187	12.038	.001	
	Dummy gender (female=1)	.234	4.248	.039	1.264	.284	5.289	.021	1.329
	Dummy nationality (foreign=1)	.764	11.354	.001	2.148	.708	8.756	.003	2.030
	Family business background (fbb=1)	.084	.486	.486	1.088	.017	.018	.894	1.017
	Dummy university (Hannover=1)	-.475	16.762	.000	.622	-.319	6.934	.008	.727
	Dummy PhD (PhD=1)	.362	4.826	.028	1.437	.400	5.321	.021	1.492
	Dummy Master (Master=1)	-.376	8.388	.004	.686	-.409	9.128	.003	.664
	Self-realization					.267	29.721	.000	1.305
	Financial success					-.426	93.706	.000	.653
	Role models					.094	7.506	.006	1.099
	Innovation					-.005	.020	.888	.995
	Recognition					-.025	.272	.602	.975
	Independence					.134	13.540	.000	1.143
	Social welfare					.022	.455	.500	1.023
Prospective Entrepreneurs	Constant term	-.608	39.053	.000		-2.837	82.979	.000	
	Dummy gender (female=1)	-.044	.231	.631	.957	.124	1.340	.247	1.131
	Dummy nationality (foreign=1)	1.032	34.596	.000	2.807	.722	12.996	.000	2.059
	Family business background (fbb=1)	.570	38.236	.000	1.769	.446	18.546	.000	1.562
	Dummy university (Hannover=1)	-.093	1.021	.312	.912	.047	.209	.648	1.048
	Dummy PhD (PhD=1)	-.374	5.257	.022	.688	-.369	4.145	.042	.691
	Dummy Master (Master=1)	-.181	3.454	.063	.835	-.242	4.927	.026	.785
	Self-realization					.207	24.177	.000	1.230
	Financial success					-.181	20.974	.000	.834
	Role models					.109	14.291	.000	1.115
	Innovation					.002	.004	.953	1.002
	Recognition					-.195	21.965	.000	.823
	Independence					.576	279.882	.000	1.779
	Social welfare					.014	.238	.625	1.014
Model Fit	Chi ²	134.782**				714.371**			
	Nagelkerke Pseudo R ²	.058				.283			
	McFadden Pseudo R ²	.026				.140			
	N	2,596				2,548			

Notes: The reference category are prospective employees.

Source: Own calculations based on GUESSS 2011.

Table 3: The Prediction of Becoming a Prospective Entrepreneur - Results of the Binary Logistic Regression Analysis

Career choice intentions: five years after studies		Model I				Model II			
		B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp(B)
Prospective Entrepreneurs	Constant term	.432	11.021	.001	1.540	-1.383	12.570	.000	.251
	Dummy gender (female=1)	-.265	4.605	.032	.767	-.199	2.027	.155	.820
	Dummy nationality (foreign=1)	.251	1.313	.252	1.286	.094	.152	.697	1.099
	Family business background (fbb=1)	.491	14.808	.000	1.633	.416	9.091	.003	1.516
	Dummy university (Hannover=1)	.396	9.894	.002	1.486	.344	6.390	.011	1.410
	Dummy PhD (PhD=1)	-.746	15.170	.000	.474	-.914	19.265	.000	.401
	Dummy Master (Master=1)	.181	1.672	.196	1.198	.136	.806	.369	1.146
	Self-realization					-.082	2.125	.145	.921
	Financial success					.223	21.463	.000	1.250
	Role models					.035	.887	.346	1.036
	Innovation					.008	.047	.829	1.008
	Recognition					-.134	6.422	.011	.875
	Independence					.404	94.554	.000	1.498
	Social welfare					-.018	.222	.638	.983
Model Fit	Chi ²	60.503**				216.995**			
	Nagelkerke Pseudo R ²	.065				.224			
	N	1,252				1,230			

Notes: The reference category are prospective scientists.

Source: Own calculations based on GUESSS 2011.

3.5 Conclusions

The aim of this paper was to investigate the relationship between students' career choice intentions, differentiating between academia and entrepreneurship, and their attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare. Based on a literature review on the career attitudes comparing entrepreneurs and scientists, I derived following hypotheses: Firstly, prospective entrepreneurs and prospective scientists have a higher desire for self-realization, recognition, independence, innovation, role models, social welfare and a lower desire for financial success compared to other individuals. Secondly, prospective entrepreneurs and prospective scientists have a similar desire for self-realization, recognition, independence, innovation, role models, social welfare and financial success.

The results of the multinomial and binary logistic regression analyses show that career attitudes determine career choice intentions among students to a great extent. Thus, career attitudes may explain and accurately predict career choice intentions among different types of students. Table 4 summarizes the expected and empirical results of the multinomial and binary logistic regression analyses. The results show that prospective entrepreneurs and

scientists have similar career attitudes. Prospective scientists are therefore well equipped with attitudes which are (also) conducive for starting a business. They have the same desire for self-realization, innovation and social welfare, whereby the last two attitudes are important for all types of students. Furthermore, although prospective entrepreneurs have a higher desire for independence and financial success than prospective scientists, they both still have a lower desire for financial success and a higher desire for independence compared to the majority of students, who want to be employees. Recognition is the only career attitude in which prospective entrepreneurs and scientists differ from each other and from other students. Prospective entrepreneurs have a lower desire for recognition compared to prospective scientists and employees, while prospective scientists do not significantly differ from employees. Regarding the impact of the individual career attitudes, the strongest influence by far on becoming an entrepreneur is the desire to be the own boss, whereas the strongest influence on becoming a scientist is a low desire for financial success.

Table 4: Summary of the Results of the Binary and Multinomial Regressions

		H.1				H.2	
		Prospective entrepreneurs versus prospective employees		Prospective scientists versus prospective employees		Prospective entrepreneurs versus prospective scientists	
		Expected	Empirical	Expected	Empirical	Expected	Empirical
A	Self-realization	+	+	+	+	o	o
B	Recognition	+	-	+	o	o	-
C	Independence	+	+	+	+	o	+
D	Innovation	+	o	+	o	o	o
E	Role models	+	+	+	+	o	o
F	Social welfare	+	o	+	o	o	o
G	Financial success	-	-	-	-	o	+

Note: (+) significantly positive, (-) significantly negative, (o) not significant. Cells colored in grey indicate that the result meets the hypothesis.

Source: Own calculations based on GUESSS 2011.

3.5.1 Contributions to Literature

The topic of academic entrepreneurship has been widely discussed in the literature since the development of the “Entrepreneurial University” and “Triple Helix” concepts (ETZKOWITZ et al. 2000). Numerous studies deal with the career attitudes of (nascent) entrepreneurs (e.g. CARTER et al. 2003; SCHEINBERG/MACMILLAN 1988; SHANE/KOLVEREID/WESTHEAD 1991). There are also more specific studies on the intention of students to become self-employed (BERGMANN/CESINGER/OSTERTAG 2012; HAASE/LAUTENSCHLÄGER 2011; TKACHEV/KOLVEREID 1999; ZELLWEGER/SIEGER/HALTER 2011). These kinds of studies mainly focus on why students choose to become entrepreneurs or not. Another stream of empirical studies focuses on why scientists leave an academic career in order to establish a company (e.g. FINI/GRIMALDI/SOBRERO 2009; FRITSCH/KRABEL 2012; GÖTHNER et al. 2012; KRABEL/MUELLER 2009; LAM 2011; NÖRR 2010; STUART/DING 2006). In utmost contrast, hardly any research has recently been conducted on the career attitudes of scientists (SAUERMAN/ROACH 2012) and a direct comparison of the career attitudes of entrepreneurs or scientists is to my best knowledge still absent from the literature.

The current study augments the present research by examining the career attitudes of students with either entrepreneurial or scientific career intentions. In this way, it is possible to investigate the original career attitudes of students who choose between academia and entrepreneurship and to give an answer to the question “How entrepreneurial are prospective scientists?” The common view is that scientists and entrepreneurs are different in their attitudes (MANGEMATIN 2000). However, the present results indicate that prospective entrepreneurs and scientists do not differ that much from each other in their original career attitudes. In other words, prospective scientists are already relatively entrepreneurial compared to prospective employees. This in turn indicates that entrepreneurs and scientists become increasingly different only after they start their careers because of the different socialization processes at a university or in a company (DING/CHOI 2011). However, there are differences between the two groups. Most importantly, prospective entrepreneurs have a greater desire for financial success and independence and a lower desire for recognition compared to prospective scientists.

3.5.2 Policy Implications

The question “How entrepreneurial are prospective scientists?” is of special interest because one objective of many universities today is to encourage university spin-off creation, according to the new “third mission” (ETZKOWITZ et al. 2000). The young university scientists of today could become those entrepreneurs of tomorrow.

The empirical results indicate that prospective scientists have relatively similar entrepreneurial attitudes as prospective entrepreneurs, so that universities do not need to be concerned about choosing young scientists not only on scientific grounds but also with respect to their entrepreneurial attitudes. However, students with a relatively high desire for financial success and independence, might be more likely to start a company as scientists later on.

Overall, the results indicate that it is definitely possible that prospective scientists start a business later in their scientific career. However, reality is different. The actual entrepreneurial activities at the universities in Hannover and Göttingen are still quite nominal (BERGMANN/CESINGER/OSTERTAG 2012; SCHMUDE/AEVERMANN/HEUMANN 2011). This suggests that the period of time during which scientists work at a university influences their future entrepreneurial activities. At this stage, support and encouragement by a supervisor (NANDA/SORENSEN 2010) as well as a strong entrepreneurial infrastructure at university might help young scientists to start a business (DEGROOF/ROBERTS 2004).

Furthermore, universities can also encourage entrepreneurial activity by sensitizing their students and fostering the development of entrepreneurial attitudes. Entrepreneurship educators as well as university teachers could include those elements into their curricula which stimulate the development of entrepreneurial attitudes, and are also valuable for a career in academia or employment (DOUGLAS/SHEPHERD 2002). This is theoretically possible, because in the course of the Bologna Process elective elements are considered and also developing key competences has become a key element in many study programs (SCHAEPER 2008). In practice, these possibilities are still insufficiently used for developing entrepreneurial attitudes.

As another possibility, the university technology transfer office could bring together students with complementary career attitudes (BREITENECKER/SCHWARZ/CLAUSSEN 2011; ENSLEY/HMIELESKI 2005). While some technically interested students might want to be innovative, other more business oriented students want to exploit a business opportunity. Creating opportunities where students with complementary career attitudes get to know each other can enhance entrepreneurial potential. For example, interdisciplinary classes in the field

of entrepreneurship with a certain credit point value could be offered. Also, the technology transfer office could actively search for inventions and product ideas at the institutes. Study projects could be carried out, in which business students develop a business plan for these inventions.

As final note, it should be said, that the overall objective of universities should be to encourage socio-economic development by contributing to the efficient allocation of human resources. Universities should make sure that career choices meet the student's preferences and abilities as well as the demand on the labor market. In this way, the students will be able to contribute the most to the overall economic development (HAASE/LAUTENSCHLÄGER 2011).

3.5.3 Limitations and Further Research

Although the present empirical study fills certain research gaps, it also reveals the need for further research. Furthermore, the results should not be interpreted without taking note of the limitations of the study, which I address in the following.

Regarding the transferability of the results it should be considered that the results are solely based on a sample within two universities in the federal state of Lower Saxony at one point in time. The results are therefore hardly transferable to other regions or time periods. For example, a survey at one point in time can suffer from effects of a university course (i.e. a charismatic teacher or a very good entrepreneurship course).

There might be a bias in this study caused by an overrepresentation of students who are interested in entrepreneurial activities and are maybe more willing to answer questions on entrepreneurial intentions. Furthermore, the career attitudes used in the survey emphasize entrepreneurship, due to the aim of the GUESSS. Further research should also integrate specific career motives of scientists. Only a very few recent studies in this field exist (ROACH/SAUERMAN 2010; SAUERMAN/ROACH 2012). The academic system in Europe has changed in the last years because of the Bologna Process (CURAJ et al. 2012) and the ambition of many universities to become more entrepreneurial (ETZKOWITZ et al. 2000). It would be interesting to investigate what has changed within the last 50 years.

This study focuses only on variables on an individual level, where students' career attitudes are the focal point. Nevertheless, it should be considered that contextual support and barriers can also influence career choices in general (DUBINI 1989; LENT/BROWN/HACKETT 2000) and - in particular - the decision to start a new firm (RIZZO 2014; STERNBERG/WAGNER 2004). A

multilevel analysis which allows to analyze nested data could therefore confer an advantage in future research (HUNDT 2012).

Also, this study only considers intentions and not actual behavior. Nevertheless, analyzing intentions has an important advantage because it avoids a memory bias (CARTER et al. 2003). A panel study would be an ideal solution for analyzing how career attitudes change and if original career preferences come true over time. A first step in this direction could be projects such as the German National Educational Panel Study (NEPS) (SCHAEPER 2013). In this way, it may also be possible to outline the path from being a scientist to becoming an entrepreneur. It would be interesting to investigate if the path leads from basic to applied research and finally to a university spin-off.

The results of this study suggest that entrepreneurs and scientists become increasingly different only after they start their careers due to the different socialization processes at a university or in a company (DING/CHOI 2011). This should be investigated more thoroughly. Thereby it may be of particular interest to investigate the influence of a career not only on the university spin-off creation but also on the subsequent university spin-off development (GÖTHNER et al. 2012; JAIN/GEORGE/MALTARICH 2009; STUART/DING 2006).

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4 Longer Is Not Necessarily Better – Career Paths of Academic Entrepreneurs and University Spin-off Growth¹⁷

Abstract

With regard to the perspectives of human capital, university status and role identity, I investigate how the career paths of academic entrepreneurs can influence university spin-off growth. 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. Instead, the willingness and ability for role identity change in terms of the degree of commitment to the entrepreneurial role is very important. Therefore, it is important to consider the career plans and growth intentions of an academic entrepreneur. In order to compensate certain disadvantages of different university statuses the formation of founding teams with complementary skills and university statuses should be promoted.

4.1 Introduction

Universities are increasingly seen as engines for regional innovation and economic growth (ETZKOWITZ 2008; LAWTON SMITH 2007; MUSTAR/WRIGHT/CLARYSSE 2008). Some famous high-tech regions have evolved on the basis of universities, for example Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (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 (CZARNITZKI/RAMMER/TOOLE 2014; EGELN et al. 2002) and a higher survival rate (LAWTON SMITH/HO 2006; ZHANG 2009) compared to average firms. This benefits regional development and is therefore a key interest among policy makers.

The focus of this paper is on the individuals who are behind these processes, those academic entrepreneurs who develop great ideas at a university and decide to put them into practice. One famous example is the Stanford University PhD Student Larry Page, who founded the

¹⁷ An earlier version of this paper is going to be published in BAPTISTA, R. and LEITÃO, J. (eds.) 2015: Entrepreneurship, Human Capital, and Regional Development, Springer.

internet search engine Google (SHANE 2004). Academic entrepreneurs do not comprise a homogeneous group. Depending on 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. The aim of this paper is to investigate how academic entrepreneurs' university career can affect university spin-off growth. For this purpose, research questions were derived from three conceptual perspectives: university status, human capital and role identity.

The relationship between the career paths of entrepreneurs and growth intentions is still inconclusive. While some quantitative studies deny an influence (BIRLEY/WESTHEAD 1994; KOLVEREID 1992) others empirically prove it (CASSAR 2007). Obviously, this relationship can hardly be investigated by quantitative analysis, because career paths are quite complex. They extend over a long period of time and many career decisions are path dependent and interrelated, so that they can hardly be forced into predefined rigid independent variables (DRUILHE/GARNSEY 2004; KODITHUWAKKU/ROSA 2002). For these reasons, my empirical analysis is based on qualitative survey data from 87 academic entrepreneurs of two German universities. The analytical process relied on a qualitative content analysis and extreme case analysis.

This paper is structured as follows: First the three conceptual perspectives are discussed and two research questions are derived (Chapter 4.2). After introducing the data and methods used in this paper (Chapter 4.3), the empirical results of the qualitative content analysis (Chapter 4.4) and extreme case analysis (Chapter 4.5) are discussed. Finally, a conclusion is drawn (Chapter 4.6) including the contribution of the study to literature, implications for policy and further research as well as limitations.

4.2 Conceptual Framework

In order to comprehensively explain the relationship between academic entrepreneurs' career paths and subsequent university spin-off growth three streams of literature are relevant: 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 the success of university spin-offs.

4.2.1 University Status Perspective

Founding a university spin-off is an outstanding event in the life of a scientist. Normally scientists reflect intensely before taking this step: if they want to take the risk, what they might lose, and what their social network would think about the decision. It is important to keep in mind that university spin-off creation is still considered to be a controversial behavior in certain universities and areas of studies in Germany (DÖRRE/NEIS 2010). In contrast to the US, the prospects of returning to academia after leaving university to start up a university spin-off are quite low in Germany (WENTLAND/KNIE/SIMON 2011).

With advancing time in university, scientists are likely to climb up the university hierarchal ladder. Empirical studies prove that an individual's position in the status hierarchy (bottom-, middle-, top-status) influences his conformity (e.g. PHILLIPS/ZUCKERMAN 2001). It may therefore be reasonably assumed that a scientist's university status influences both the decision to create a university spin-off as well as subsequent university spin-off growth.

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 certain norms are expected. This freedom enables them to generate extraordinary innovations apart from social group norms (PHILLIPS/ZUCKERMAN 2001), which can be advantageous for university spin-off growth. However, this also leads to certain disadvantages. 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 a 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 conservatively (PHILLIPS/ZUCKERMAN 2001). On the one hand they have already reached a certain status that they would risk losing. On the other hand they have not gained the reputation and resources to an extent that gives them the security and freedom as is the case for high status entrepreneurs (PHILLIPS/ZUCKERMAN 2001). 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 (GARNSEY 1998) 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 as long as the university spin-off matches existing social group norms (PHILLIPS/ZUCKERMAN 2001).

Individuals with a high university status, especially star scientists, usually possess good access to resources and information to be able to cope with and evaluate the risks connected with founding a university spin-off (PHILLIPS/ZUCKERMAN 2001). They enjoy a high level of reputation within their field and social network. This makes it easier for them to gain initial credibility, acquire funding and attract customers (SHANE 2004), which is advantageous for university spin-off growth. Following PHILLIPS and ZUCKERMAN (2001) it can be assumed that high university status entrepreneurs tend to exploit opportunities, which are in line with the norms of their social network.

In summary, with increasing university status, reputation and access to resources through the social network usually increase (DING/CHOI 2011), which in turn is advantageous for university spin-off growth.

4.2.2 Human Capital Perspective

According to the human capital theory, individuals are endowed with skills and knowledge and can increase their overall knowledge through investments in their human capital like schooling, on-the-job-training, searching for information, etc. (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 (DING/CHOI 2011; SHANE 2004). This argument also received empirical support (KLOFSTEN/JONES-EVANS 2000).

In the field of entrepreneurship, investments in human capital are usually seen as an advantage in terms of a company's survival, growth and profitability (COLOMBO/GRILLI 2005; PARKER 2005; SHANE 2004; STÜTZER 2010). However LAZEAR (2005) differentiates between employees and entrepreneurs. While employees tend to be specialists in their field, entrepreneurs should rather be a Jack-of-all-Trades. This means entrepreneurs have to combine different skills. Large investments in one special subject are an obstacle for becoming a successful entrepreneur. According to LAZEAR (2005), it is quite obvious that scientists obtain 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 (DAVIDSSON/HONIG 2003). Especially in the context of university spin-offs a positive relationship between human capital acquisition in a university and a university spin-off's success is not inevitable (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 (MURRAY/HÄUBL 2007).

The acquisition of scientific expertise in a 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 (BATHELT/KOGLER/MUNRO 2010; EGELN et al. 2002; KARNANI/SCHULTE 2010). Exploitation spin-offs are based on concrete research results or novel methods, which at least one academic entrepreneur has developed at a university. Competence spin-offs emerged from specific knowledge or skills, which at least one academic entrepreneur has acquired in a university. The academic entrepreneur's specific competence enables him or her to develop the original idea further, oftentimes even independently from the university. By contrast, academic start-ups comprise only generic knowledge or skills, which at least one academic entrepreneur has acquired in a university (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 with 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 (EGELN et al. 2002).

4.2.3 Role Identity Perspective

Scientists and entrepreneurs have in principle two opposite value systems and academic entrepreneurs obviously operate within this area of tension (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 their roles to become successful academic entrepreneurs (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 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 writing applications for research projects to acquire funding and they are mainly interested in a technological success (STEPHAN/LEVIN 1996). German scientists improve their reputation mainly through own

publications in highly specialized journals and secondly through teaching, whereas patenting, technology transfer and entrepreneurial activity are less important (WENTLAND/KNIE/SIMON 2011). So if scientists transfer their academic habits to their new roles as entrepreneurs, they might fail to orientate to the market and to force economic success through identifying buyers and making marketing (NÖRR 2010).

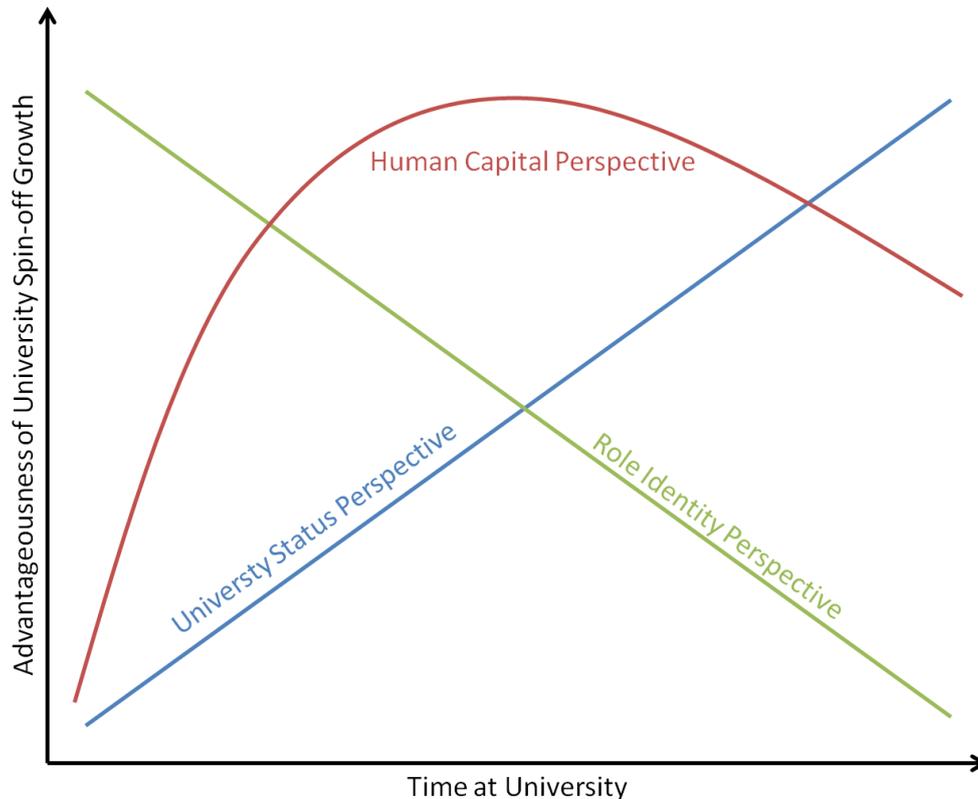
ERDÖS and VARGA (2012) rightly state that empirical studies hardly consider the role of scientists as entrepreneurs. Adopting new roles is a difficult task especially for scientists, who pass through a long-term university career before founding a university spin-off. Due to the long and intense socialization process in a university (DING/CHOI 2011), 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 (MANGEMATIN 2000). 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 a university for a long time, identify themselves to 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 a university and run the university spin-off only part-time (BRAUN-THÜRMAN/KNIE/SIMON 2010; JAIN/GEORGE/MALTARICH 2009; NICOLAOU/BIRLEY 2003). Empirical evidence exists that it is important whether an academic entrepreneur has left the university to set up a company or not (PIRNAY/SURLEMONT/NLEMVO 2003; SHANE 2004). Heading the university spin-off only on a part-time basis bears the risk of reducing personal commitment and thereby growth expectations (DOUTRIAUX 1987; EGELN et al. 2002).

4.2.4 Developing Research Questions

In the conceptual discussion the importance of an academic entrepreneur's career path for university spin-off growth was explained through three different perspectives. Career paths are quite complex, as the above described conceptual perspectives result in competing expectations for university spin-off growth (see Figure 19). Furthermore, career paths extend over a long period of time and can contain breaks. For these reasons, it is appropriate to base the empirical analysis on a qualitative research design. Qualitative research generally focuses on analytical instead of statistical generalization (MILES/HUBERMAN 1994). In the following analysis of the career paths of academic entrepreneurs I investigate:

1. How do the university status, human capital and role identity influence university spin-off growth.
2. How do the university status, human capital and role identity interact with each other?



Source: Own illustration.

Figure 19: Conceptual Framework on the Three Perspectives of Career Paths

4.3 Data and methods

Different approaches for collecting and analyzing qualitative data exist (BERNARD/RYAN 2009). With the means of a qualitative content analysis I first investigate how the university status, human capital and role identity separately influence university spin-off growth. In order to determine university spin-off growth, I look at the number of employees. For this analysis I use the whole sample. Then I conduct a comparative analysis of selected extreme cases. I identify three academic entrepreneurs of high growth university spin-offs and three academic entrepreneurs of low growth university spin-offs with similar career paths and analyze their career paths in depth. In this way it is possible to show the importance and interaction of the three perspectives.

4.3.1 Defining Academic Entrepreneurs

Following PIRNAY et al. (2003) and SMILOR et al. (1990) I defined academic entrepreneurs as scientists or students who left a university to start a company or who founded (or co-founded) a company while still affiliated with a 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 (e.g. SMILOR/GIBSON/DIETRICH 1990), I take a broader view of knowledge transfer by including academic entrepreneurs of knowledge intensive service companies (e.g. also RAPPERT/WEBSTER/CHARLES 1999).

I analyze university spin-offs which were founded from 1980 until 2011. The time between leaving a university and the official business formation did not exceed a maximum of three years because this study investigates spin-offs based on university knowledge. The temporal boundary of a maximum of three years is a good compromise. On the one hand I avoid taking entrepreneurs into account, who gained significant knowledge in the private sector (PIRNAY/SURLEMONT/NLEMVO 2003; WENBERG/WIKLUND/WRIGHT 2011). On the other hand a sufficient time period is necessary for setting up a company, especially in high-tech sectors.

4.3.2 Data Collection and Sampling Approach

A wide range of literature already exists on top universities and regions like Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (SAXENIAN 1983; STERNBERG 1995). In this paper, the cases were drawn from the two biggest universities in Lower Saxony, Germany with regard to the total number of students¹⁸, the number of students in subjects which are common for university spin-offs¹⁹, the number of scientific staff, and research expenditures (KULICKE et al. 2008). The two chosen universities, Hannover and Göttingen, are particularly suitable examples for German mid-range universities located in regions outside high-tech clusters. At this kind of university individual characteristics and career paths play an important role for university spin-offs, because only a weak entrepreneurial support structure exist (see Chapter 2).

¹⁸ Leibniz Universität Hannover had 21,478 students and Georg-August-Universität Göttingen 26,381 students in the summer semester 2013 (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2013b; LEIBNIZ UNIVERSITÄT HANNOVER 2013b).

¹⁹ These are the MINT subjects (mathematics, computer science, natural science and engineering) and medical science (KULICKE et al. 2008). MINT subjects are comparable to the STEM fields used in English. These include science, technology, engineering and mathematics.

Since the data on university spin-offs in Germany is far from being accurate, the data used in this paper was collected within the framework of a broader research project²⁰. The current study should therefore also give an overview on university spin-off activities at the two chosen universities. For this reason a more comprehensive approach to data collection was chosen compared to other qualitative studies (BAKER/EDWARDS 2012). In order to identify as many academic entrepreneurs as possible the total sample of university spin-offs for the two universities was composed as follows:

In the first step of data collection I had informal discussions with leaders of the technology transfer offices and employees of different economic development agencies in the two survey regions Hannover and Göttingen. I 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, I initiated a search operation through the business network XING in order to capture any university spin-offs, which had contact neither with the current faculty staff nor with the technology transfer offices nor with 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 searches. In many cases it was not clear if a business was from an academic entrepreneur according to our definition. In total, I obtained a list of 334 academic entrepreneurs. From this population, 152 academic entrepreneurs were asked for an interview. 65 were unresponsive or did not agree to an interview. A sampling grid was used to ensure a heterogenic sample structure (BERNARD/RYAN 2009; SCHREIER/NADERER/BALZER 2007). The cases were equally distributed throughout the two basic categories: students or scientists.²¹

In the third step of data collection, I had semi-structured face-to-face interviews with 87 academic entrepreneurs (BERNARD/RYAN 2009) during the period of September 2011 to January 2012.²² The face-to-face interviews usually took place in the respective company and ranged from 45 minutes to two and a half hours in length.²³ The vast majority of interviews

²⁰ See acknowledgements at the end of this chapter.

²¹ Although the cases were also equally distributed between the two chosen universities, I did not differentiate the academic entrepreneurs according to their parent university in this study, because this was only relevant for the research project. For the aim of this present study the parent university was not relevant.

²² All interviews were anonymized for data privacy reasons. Therefore, the interview partners are not listed in the annex.

²³ A few academic entrepreneurs were interviewed at neutral places or by telephone due to distance, space or scheduling problems.

was openly recorded and directly transcribed.²⁴ Throughout the interviews, I asked open-ended questions pertaining to the chronological career path before the university spin-off as well as the phases of preparing, establishing, and developing the university spin-off (RASMUSSEN 2011; ROBERTS/MALONE 1996; VOHORA/WRIGHT/LOCKETT 2004), as shown in Annex 3. During and after the interviews the interviewer took field notes. Furthermore, a post-interview questionnaire (see Annex 4) and information collected from the university spin-off websites and press articles augmented the data.

4.3.3 Data Coding and Analysis

In the first step, I conducted a qualitative content analysis with all 85 transcribed interviews (GLÄSER/LAUDEL 2009; MAYRING 2008b) which was supported by the qualitative data analysis software NVivo. Table 5 shows important factors derived from the three conceptual perspectives. In the qualitative content analysis these factors were considered.

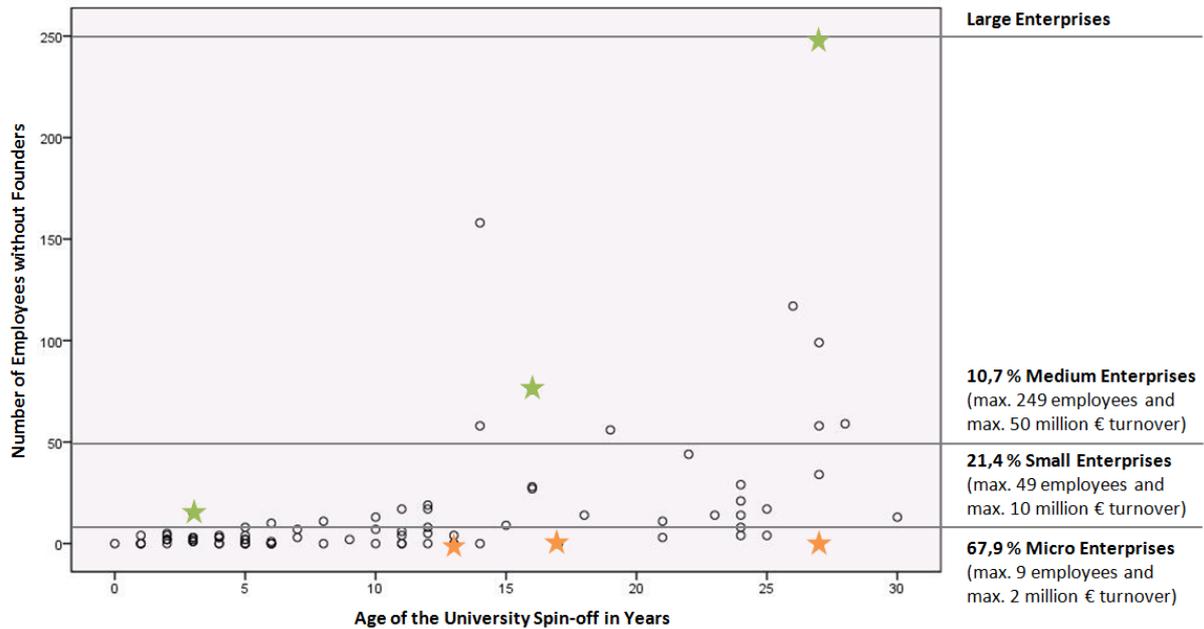
In order to differentiate different university statuses I developed six categories which show the university status of every academic entrepreneur at the time of the university spin-off creation. The different university statuses are categorized as follows: (1) “Students” who were still studying at the university. (2) “Graduates” who founded the university spin-off after graduating from the university. (3) “Doctoral students” or research associates without a doctor’s degree (4) “Doctors” who had already achieved the doctoral degree and left the university. (5) “Postdoctoral fellows” who worked at a university after achieving the doctoral degree. In most cases the individuals were working on their habilitation²⁵. (6) “Professors” including private lecturers, adjunct professors and emeriti. In this category the individuals had finished their habilitation.

²⁴ In a few cases a content protocol was written during the interview if the interviewee did not want to be recorded.

²⁵ Qualification phase after the doctorate for a teaching career in higher education.

Table 5: Coding Frame for Academic Entrepreneurs' Career Paths

Conceptual perspectives	Important factors	Description	Examples
University status perspective	Reputation and access to resources through social network	Contacts to and recognition in scientific community and private economy	<i>"The professorial image helped me a lot at the beginning, but of course it also commits me to always do more than my competitors." (USO68)</i>
	Independence	Independence of university spin-off from parent university or dependency between university spin-off and parent university	<i>"The only risk, which is a 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." (USO68)</i>
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	<i>"It was definitely an exploitation of university know-how." (USO14)</i>
	Management skills	Mention of management skills acquired at university on-the-job, which were helpful for university spin-off	<i>"Fortunately, as a group leader, I had to do personal management, financial management and so on. I had a group of 15 people and I was fully responsible scientifically and financially." (USO02)</i>
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	<i>"It actually came directly with the idea. Before I didn't have a plan like I have to be self-employment when I am 40 or so." (USO07)</i>
		Mention of difficulties concerning role identity change in terms of profit orientation, workload, etc.	<i>"I had to grow into this role as an entrepreneur. And it took some time." (USO33)</i>
	Commitment to university spin-off	Differentiation between left university and still works at university	<i>"When I founded the company, I actually quit the scientific career for myself." (USO17)</i>



Note: N = 85. One case corresponds to one university spin-off. Number of employees is based on full-time equivalents. Categorization of enterprises in accordance with the FEDERAL BUREAU OF STATISTICS (2013). Selected cases for extreme case study highlighted in yellow and green.
Source: Own survey 2011.

Figure 20: Identification of Extreme Cases Measured according to University Spin-off Size

On the basis of the qualitative content analysis of all interviews, I conducted a comparative extreme case analysis in the second step. Therefore I identified three academic entrepreneurs of high growth university spin-offs and three academic entrepreneurs of low growth university spin-offs measured according to the increase of employees (see Figure 20).²⁶ These six academic entrepreneurs are combined to three pairs with very similar career paths but very different university spin-off growth. This approach is especially useful for a contrasting comparison and an identification of the possible best practice. Although high growth university spin-offs are rather rare in our samples, they are of course the most favored by policy makers and most eligible for support because they have a high influence on regional economic growth. In contrast, low growth university spin-offs have a weak influence on regional economic growth but they occur more frequently and also contribute to regional economic diversity and innovation (COHEN/KLEPPER 1992). The selection of extreme cases

²⁶ Firm's performance can be measured in many different ways. Common indicators used in literature are survival rate, employment growth, sales growth, productivity and credit rating (HELM/MAURONER 2011). 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 (DAVIDSSON/ACHTENHAGEN/NALDI 2007; WIKLUND 1998). Furthermore, it is less susceptible to fluctuations and a good indicator for the university spin-offs' overall assets (GIBCUS/STAM 2012). Nevertheless, these propositions do not apply to all branches equally. Other definitions of university spin-off growth could lead to different results. Furthermore, university spin-off growth should not be equated with success, because success always depends on the respective business goals (HAYTER 2010).

shows more specifically how the career paths of academic entrepreneurs contribute to university spin-off growth.

4.4 Results of the Qualitative Content Analysis

Based on the conceptual perspectives discussed above and by using a qualitative content analysis, I show how university status, human capital and role identity can affect university spin-off growth. The results for each conceptual perspective are explained in individual chapters and different university statuses are addressed.

4.4.1 Results from the University Status Perspective

In the following, I present the results concerning the expectation that academic entrepreneurs with a higher university status may be more likely to found a high growth university spin-off. I discuss the advantages and disadvantages of low, middle and high university status entrepreneurs successively.

Low status university entrepreneurs who start a university spin-off, such as students and graduates, have low entry barriers. In accordance to the theoretical assumption, several of them reported that they were used to coping with little income anyway and were willing to take risks, as the following quotation of a graduate indicates: *“Now we are studying and get along with little money. Now we can see what happens if we start a company with ideas which were brought to the university’s attention but 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 a university career, an individual is also more willing to learn something new and to adapt to new situations quickly. Low status academic entrepreneurs have only little responsibility in their private and professional lives and have more freedom. On the other hand, some students and even graduates had to cope with legitimacy problems in the first years, as one student reports: *“We had the image of a students’ firm for many years. We had to fight for a long time. Especially the authorities did not taken us seriously, although this was actually unfounded 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, such as scientific and technical services, it is. Established scientists normally do not have to cope with such prejudices.

Middle university status entrepreneurs, such as doctoral students, also enjoy a high degree of freedom because in Germany they usually have part-time contracts. They can plan the rest of their time relatively freely, as this doctoral student states: *“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 a university, writing a doctoral thesis and establishing a university spin-off is often a hard struggle for doctoral students. This struggle becomes even harder the more successful a university spin-off becomes. As a result, it may take doctoral students longer to finish a thesis. In some cases they may quit their academic career, as one third of the doctoral students in the sample did. Nevertheless, having a doctoral degree of course bears several advantages which make it possibly worthwhile to finish a doctorate before founding a university spin-off. For example, customers often have a higher trust in the quality and reliability of a company and a doctoral degree can also open doors.

High university status entrepreneurs, such as postdoctoral fellows and professors, usually possess a high reputation. This makes it easier for them to gain legitimacy for a university spin-off. Yet these laurels in advance also oblige the academic entrepreneur to be more innovative and better than competitors, as this professor states: *"The professorial image helped me a lot at the beginning, but of course it also commits me to always do 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 expectations of customers 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 a full commitment (see Chapter 4.4.3).

The majority of university spin-offs founded by high status academic entrepreneurs are listed in the sector "scientific services", as mentioned before. This fact hinders the long-term growth of a company because the economic success of a 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 a 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. 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 concept. I think it will continue quite well as long as*

I am 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 university status show that the reputation helps in terms of gaining legitimacy early on. This is especially useful at the beginning of the university spin-off but in the long run this can develop into 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. Instead it is important to decouple the university spin-off from the academic entrepreneur and the university in the long run to achieve high growth (RASMUSSEN/BORCH 2010).

4.4.2 Results from the Human Capital Perspective

In the following, I present the results concerning the second expectation that increasing human capital and resulting knowledge transfer may have a diminishing marginal utility for university spin-off growth and may even become disadvantageous. 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 a university.

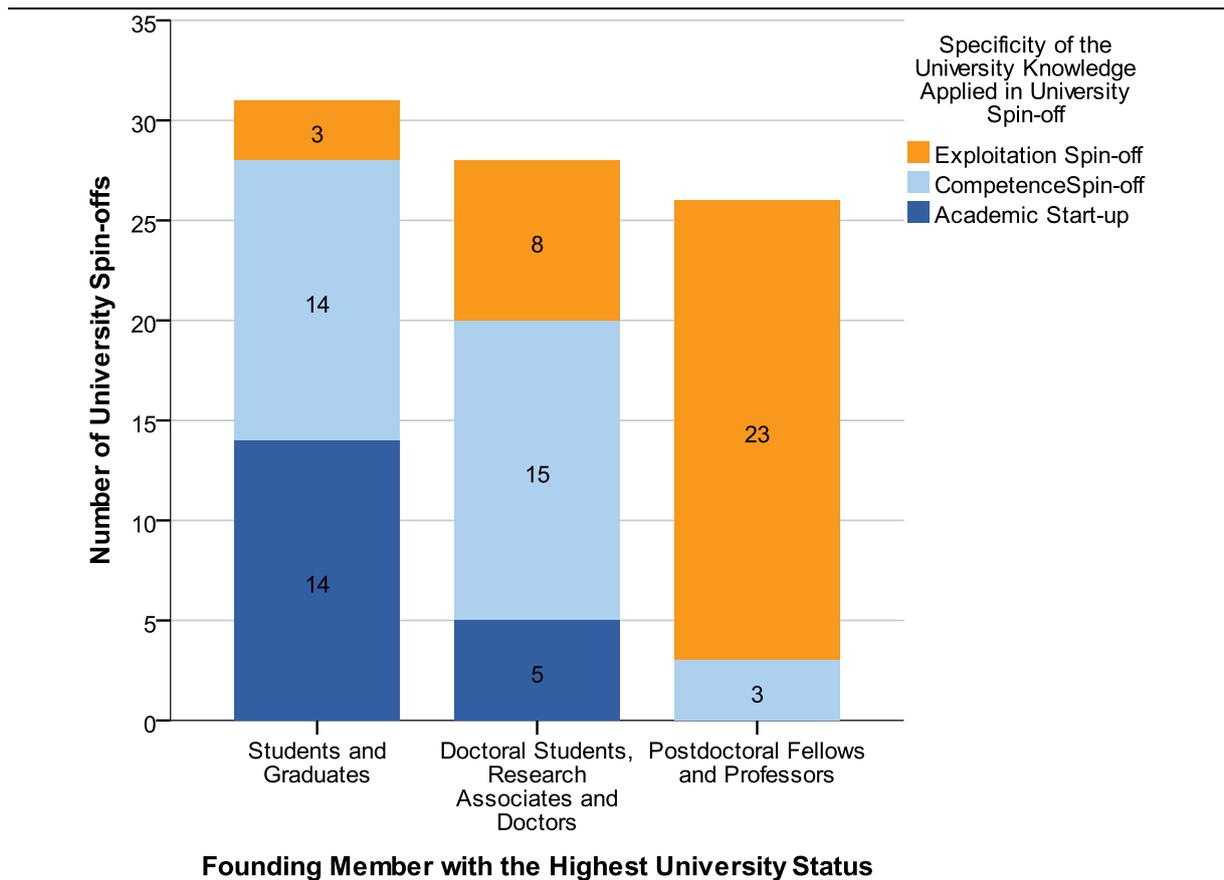
Students and graduates, who discover a market gap and decide to exploit it, usually start up a university spin-off on the basis of the knowledge he or she acquired during studies. Transferring research results into practice plays a rather minor role at this low university status. Sometimes results of the diploma thesis or knowledge gained 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, experience 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 a doctor’s degree) and doctors acquire profound scientific expertise in a certain subject during doctoral studies and research projects. The majority discover a market gap based on 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 a market entry. Many doctoral students, research associates and doctors start up a university spin-off because the industry partners have a concrete demand for a 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 areas, because they researched different projects for many years. The majority of them discovered a market gap due to their research and consultant activities. Industry contacts of course are also very helpful and facilitate a market entry.

Figure 21 shows the different characteristics 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 shifts 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 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 often 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.



Valid cases: 85.
 Source: USO survey 2011.

Figure 21: Knowledge Transfer and University Status

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

Students and graduates do not only possess little scientific expertise but also only little working experience which is mostly based on student projects, internships, part-time jobs or diploma theses. Accordingly, they have only little experience in project management. In the early phase of a university spin-off, they may 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 time limits. This can lead to order cancellations from customers and severe image damage. However, such initial problems are not serious in most cases, so that university spin-offs develop well, as this quotation of a student shows: *“Of course we only had 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 youthful ease may help get over initial difficulties.

Doctoral students, research associates and doctors have already acquired working experience in a university which is valuable for founding a university spin-off. Many of them already have experience in applying for, managing and evaluating research projects, as this quotation of a doctoral student shows: *“Before, I made my living at the university with 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 for support offers. I am able to overview that quite quickly.”* (USO33).

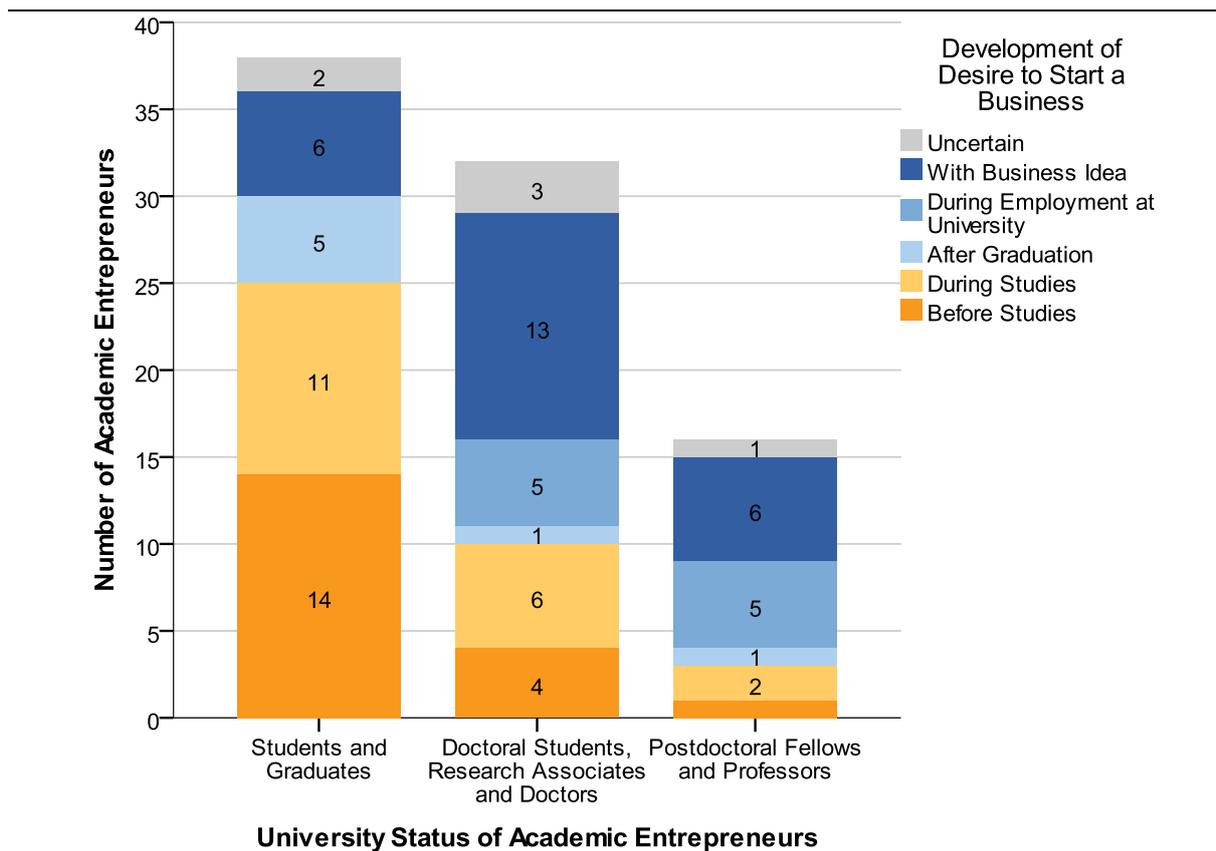
Alongside the lower university status skills, postdoctoral fellows and professors are usually also responsible for personnel. Therefore, they attain valuable skills in personnel management as this postdoctoral fellow remarks: *“Fortunately, as a group leader, I had to do personal management, financial management and so on. I had a group of 15 people and I was fully responsible scientifically and financially.”* (USO02).

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

4.4.3 Results from the Role Identity Perspective

In the following, I present the results concerning the third expectation that difficulties with role identity change may increase with advancing time in a university and hinder university spin-off growth. Therefore, I address the statements made by longstanding university staff that concern the 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 that, they either never thought about becoming an entrepreneur or they did not even want to become an entrepreneur (see Figure 22). Especially for academic entrepreneurs with a high university status, the desire for entrepreneurship only developed with a concrete business idea quite late in their university career and oftentimes 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 during the initial years.



Valid cases: 86.
Source: USO survey 2011.

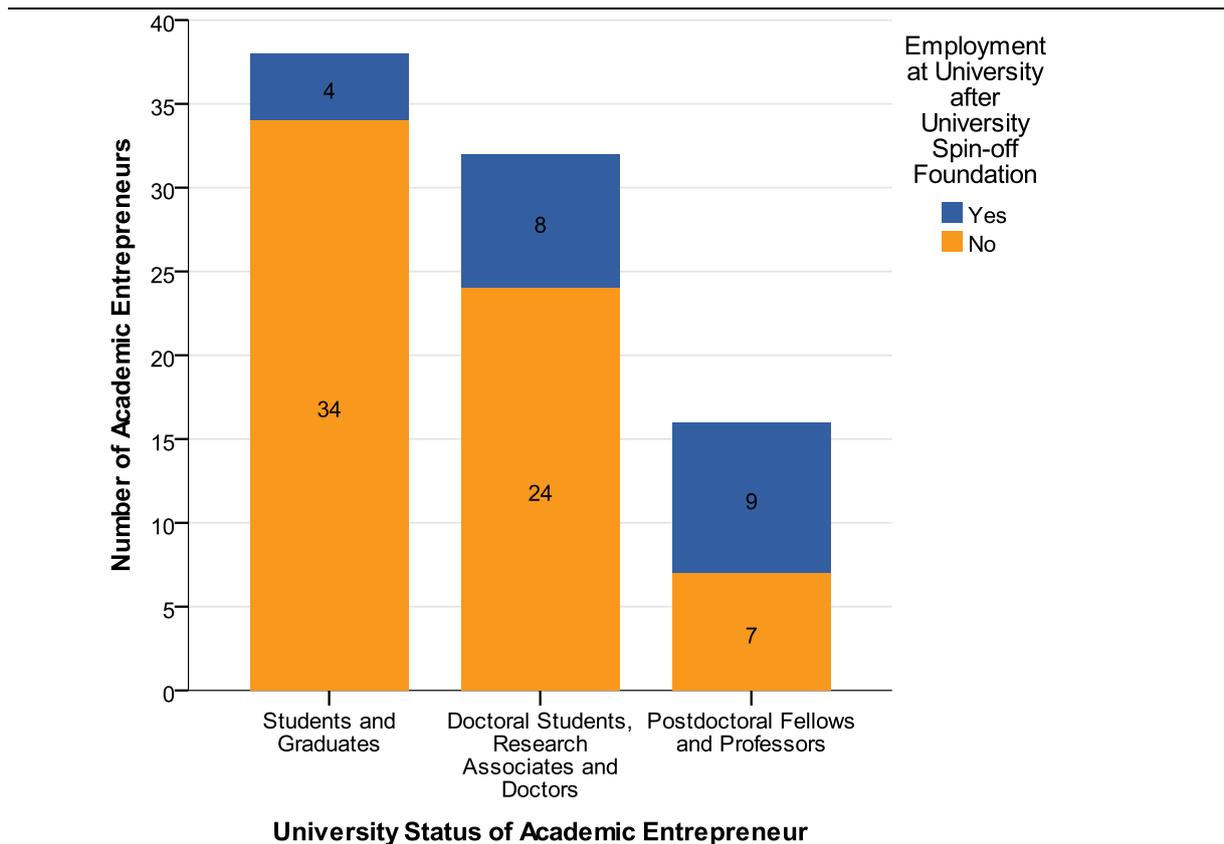
Figure 22: Development of the Desire to Be Self-employed

For example, a professor reported that it was 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 basic 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 livelihood.” (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 viewpoint, as this professor vividly described: *“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 businessman; whether something comes out of it at the end of the day or whether it is only a little fun.”* (USO41).

In regards to the commitment to the entrepreneurial role, the academic entrepreneurs in our study can be divided into two groups. On the one hand there are academic entrepreneurs who wanted to change their role and ended 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 the 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 23). For some of these individuals the university career served solely to finance themselves in the initial years of business. However this career path can also be chosen because of opposite motives. For these individuals, the university career is the first choice. They never plan to be a full-time entrepreneur and leave university because they would rather do research and teaching. The question then is, why do these individuals startup a university spin-off in the first place. Individuals, who target a university career, see the university spin-off as a good opportunity either to finance their subsequent university career or to gain a reputation as a university professor later.



Valid cases: 86.
Source: USO survey 2011.

Figure 23: Employment at University after University Spin-off Foundation

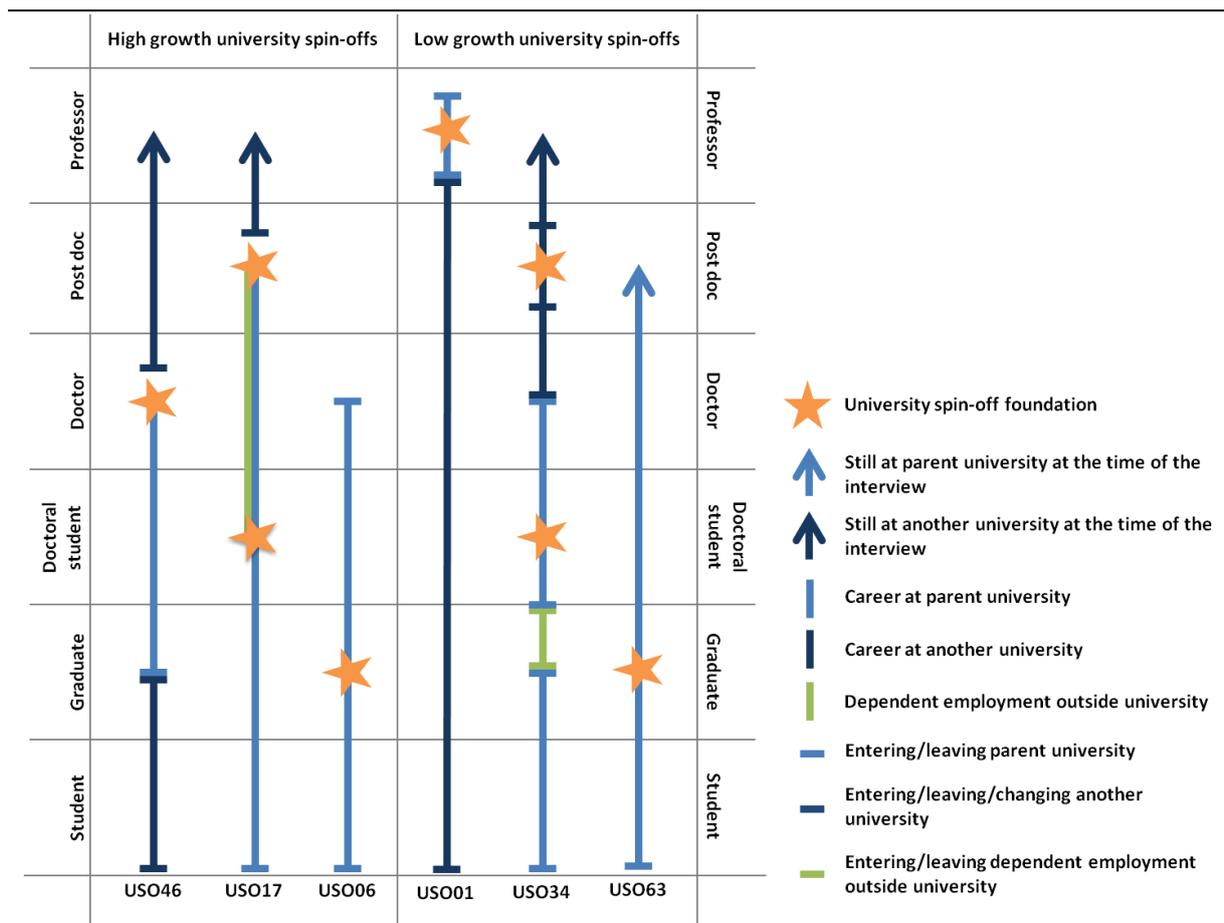
Many postdoctoral fellows in the sample decided to startup a university spin-off because they suffered from a lack of job security in the university due to part-time and fixed-term contracts. Usually postdoctoral fellows have almost no experience in the private sector but at the same time they are highly qualified and possess a mature personality. This makes it very difficult for them to find a subsequent job as a dependent employee in the private sector in case their contracts are not extended or they do not find a professorial chair after their 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 a 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 a good chance to establish big university spin-offs. Postdoctoral fellows who have discovered a market gap on the basis of their research projects and are 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 often leads to high financing needs and delayed growth.

For the professors in the sample, the university career is definitely in first place and the university spin-off is of secondary importance. 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. Therefore, most professors do not start a university spin-off with a full commitment. More often professors are members of the founding team and 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 a 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 holder. I myself am actually responsible for the operating business, the rest is strategic advance, let’s 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 becomes increasingly difficult with longer working times in a university. Especially postdoctoral fellows and professors reported that they had trouble with this, whereas students and graduates who are at the beginning of their university careers, hardly ever described such problems. In contrast to management skills, the attitude towards entrepreneurship and adaption to a new value system are harder to learn. The socialization process, which takes place in a university, should therefore not be underestimated. As a result, with advancing time in a university and rising university status the commitment for an entrepreneurial role tends to decrease.

4.5 Results of Extreme Case Analysis

In this chapter I show the importance of and interaction between the three conceptual perspectives for selected cases. I identified three positive and three negative extreme cases in the samples in terms of university spin-off growth measured as the 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 24).



Note: Results of the extreme case analysis. 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. Source: Own illustration, USO survey 2011.

Figure 24: Academic Entrepreneurs' Career Paths

In order to explain the importance of the willingness of role identity change, I compared the career paths of two academic entrepreneurs with the case numbers USO17 and USO34 (see Figure 24). At first glance the interviewees have much in common. The two university spin-offs are founded in knowledge-intensive services and the academic entrepreneurs were still working at the 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 left the university when founding his second university spin-off. The decision to leave the university was not quite voluntary. 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 actually quit the scientific career for myself.”* (USO17). Later he describes of 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 then decided to continue his university career and finish his habilitation after all. In contrast, the academic entrepreneur of the low growth university spin-off left the university after graduation, but after a short time in the private industry he realized that he wished to pursue a university career. Although he is shaped entrepreneurially by his family, he returned to the university. He founded the two university spin-offs because they forwarded his university career. He never had the intention to leave university to be 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 24). 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 the university and my partner leads the company with full commitment, so that we try to ensure a certain seed funding. I received a regular salary at the university, while my self-employed partner did not earn any money 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. I still write scientific studies.”* (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, at least for the initial years, usually stay small (see also Figure 24).

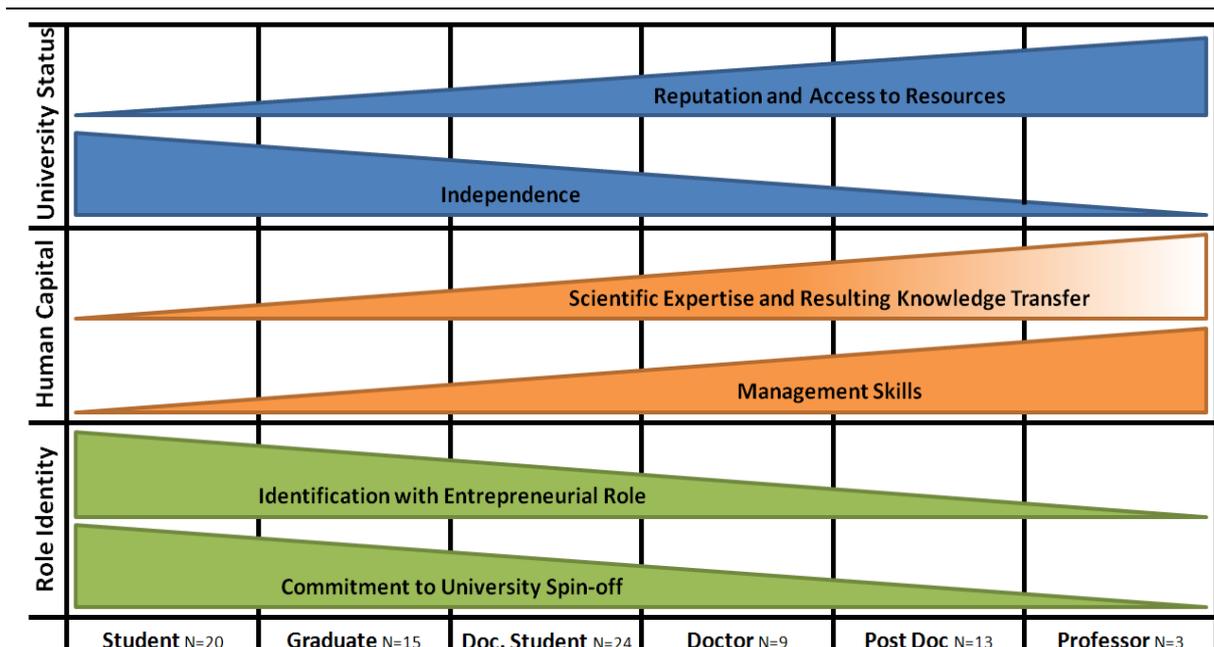
In order to explain the interaction and evolving disadvantages from scientific expertise, deriving knowledge transfer and university status, I compared the academic entrepreneurs with the case numbers USO01 and USO46 (see Figure 24). The interviewees have in common that they founded exploitation spin-offs in the service sector. During their research projects they both acquired a good reputation and established a wide social network not only within the scientific community but also to partners in the 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 was still so high that the continuation of the business or the sale of the university spin-off to another professor was simply impossible. In contrast, the high growth academic entrepreneur USO46 acknowledged 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.

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 the high reputation and their social network, these advantages are more 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 the identification with the entrepreneurial role and the willingness to manage the company with full commitment at least in the initial years.

4.6 Conclusions

Referring to the title of this paper it can be stated that a 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; summarized in Figure 25. Academic entrepreneurs are located in a trade-off. With advancing university status the reputation and access to resources, the scientific expertise and resulting knowledge as well as the management competence of a person of course increases. Nevertheless, some examples show that a high degree of scientific expertise and the resulting knowledge transfer in connection with a high university status even develop into a disadvantage for long-term university growth due to a high dependency on the academic entrepreneur and on the university. 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 (DOUTRIAUX 1987; NICOLAOU/BIRLEY 2003). The willingness and ability for a role identity change in terms of commitment to the entrepreneurial role is very important for the growth intention of an academic entrepreneur and subsequent university spin-off growth. At least one founding member should work in the university spin-off with full commitment in the initial years. Overall, the results indicate that the cognitive ability and the social network of an academic entrepreneur are important to achieve university spin-off growth. However, the growth intentions also play a crucial role.



Note: Summarized results of the content analysis. Fading color of the triangle “Scientific Expertise and Resulting Knowledge 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.
 Source: Own illustration, USO survey 2011.

Figure 25: Advantages of University Career for University Spin-off Growth

4.6.1 Research Implications

The study contributes to a better understanding of the career paths of academic entrepreneurs and the effects on university spin-off performance by using three different research perspectives: human capital (BECKER 1975; LAZEAR 2005), university status (PHILLIPS/ZUCKERMAN 2001) and role identity (JAIN/GEORGE/MALTARICH 2009; MERTON 1973). The current study thereby also contributes to the existing literature on university spin-off development and performance because, in contrast to the existing literature, it considers the time at university as being important for the subsequent university spin-off performance.

Examining career paths is quite a complex task. They extend over a long period of time and include decisions which are path dependent and interrelated (DRUILHE/GARNSEY 2004; KODITHUWAKKU/ROSA 2002). The relationship between the career paths of entrepreneurs and growth intentions is therefore still ambiguous. While some quantitative studies deny an influence (BIRLEY/WESTHEAD 1994; KOLVEREID 1992) others empirically prove it (CASSAR 2007). The qualitative research design has thereby proven to be a great advantage for analyzing the career paths of academic entrepreneurs.

The results of this study show that the role identity change and the resulting growth intention of an academic entrepreneur have a crucial influence on university spin-off growth. Although some empirical studies in the recent past have suggested that entrepreneurial growth

intentions are important for subsequent business growth (CASSAR 2007; DOUGLAS 2013; GUNDRY/WELSCH 2001; HERMANS et al. 2012; STAM et al. 2007; VAN STEL et al. 2010), this issue has hardly been considered in the field of academic entrepreneurship. Further research should therefore consider growth intentions as being important for university spin-off growth and investigate this relationship more in-depth.

The results of this study furthermore show that only a minority of university spin-offs belongs to the group of high flyers and many lead a university spin-off on a part-time basis. Further research should therefore look at self-employment as a part-time job for scientists. This phenomenon has only received little attention in literature (JAIN/GEORGE/MALTARICH 2009; NICOLAOU/BIRLEY 2003), although it might represent an untapped potential for the university and the region. Also, 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 and do not receive any financial benefit.

4.6.2 Policy Implications

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 the university status and career plans of an academic entrepreneur, in order to compensate particular disadvantages of different university statuses and to recognize an academic entrepreneur's growth intention. Furthermore, I recommend to support the formation of founding teams with complementary skills and university statuses (BREITENECKER/SCHWARZ/CLAUSSEN 2011; ENSLEY/HMIELESKI 2005). Students and doctoral students usually have a high willingness to learn. This might diminish the cognitive distance between professors and management graduates (NOOTEBOOM et al. 2007). The professor's scientific expertise would be coupled with the students' risk disposition and flexibility. The graduates therefore could profit from the professor's reputation and far-reaching social networks. Nevertheless some problems might occur. 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. This empirical study describes 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.

4.6.3 Limitations

Although the present empirical study fills certain research gaps, one needs to consider the results in the context of limitations, which I address in the following. Firstly, limitations regarding the transferability of the results should be considered. The results are solely based on a sample within the German context, whereas both universities are located in the same federal state with comparable environments. Despite several reasons justifying this approach (see Chapter 4.3), it should be noted that the results are therefore hardly transferable to other regions or countries.

Secondly, the following data-related biases should be considered. The study is largely based on established university spin-offs. I only contacted those academic entrepreneurs who were still on the market at the time of the survey, although a large number of academic entrepreneurs does not succeed in establishing and running a university spin-off (GARNSEY 1998). Furthermore, I only took private limited companies and corporations into account. Thus, a general success bias might exist. One could also assume some bias due to non-response. However, those academic entrepreneurs who did not respond to our contact request, could be either less or more successful. Some may be embarrassed, others could be too busy. I interviewed academic entrepreneurs ex-post. A retrospective study always tends to suffer from some kind of memory decay. There is a risk that outcomes are assigned to circumstances that did not in fact exist at that time.

Finally, the qualitative content analysis is only focused on the differences of university statuses and their influence on university spin-off growth. Nevertheless, advantages and disadvantages exist which many of our interviewees had 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 our sample. Independently from the university status, some academic entrepreneurs in the sample had prior entrepreneurial experience and therefore huge advantages. However, the vast majority of the interviewees had to cope with a lack of business knowledge. Because of the novelty of the products and services it was difficult to estimate market potential and customer demand. Many of our sampled entrepreneurs had problems in entering the market.

Acknowledgements

This work was prepared in the context of a research project “University spin-offs in Lower Saxony and their regional economic impact: empirical evidence from Hannover and Göttingen”. It was funded from 2010 to 2013 by the Ministry for Science and Culture of Lower Saxony, grant no. AZ. 76202-17-5/09. My special thanks go to my research team members Rolf Sternberg and Arne Vorderwülbecke as well as the interviewees for sharing their stories and insights. Furthermore I would like to thank Jürgen Brünjes at the German Centre for Research on Higher Education and Science Studies (DZHW) and my other colleagues at the Institute of Economic and Cultural Geography of the Leibniz Universität Hannover as well as the discussants and participants at the DRUID Academy Conference 2013 and 53rd European Regional Science Association Congress for their valuable comments on an earlier draft.

5 Why Do Most University Spin-Offs Remain Small?²⁷

Abstract

Based on a specific concept of growth phases, I investigate why the majority of university spin-offs remain small. The aim of this paper is to illustrate and understand the complexity of university spin-off growth through qualitative research methods. By matching the willingness of academic entrepreneurs to the ability of university spin-offs to grow, four basic types of university spin-offs are derived: ambitious, unwilling, saturated and impeded university spin-offs. By combining theoretical considerations and empirical regularities from 68 university spin-offs I construct eight different subtypes of university spin-offs. The results show that the majority of university spin-offs either lacks entrepreneurial growth intentions or is impeded by reasons caused by personal characteristics of the academic entrepreneur, the university spin-off or the external environment. Some subtypes like life stylists, entrepreneurial academics and late bloomers face problems or share attitudes that are very specific in the context of university spin-offs.

5.1 Introduction

Universities are increasingly seen as engines for regional innovation and economic growth (ETZKOWITZ 2008; LAWTON SMITH 2007; 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 (SAXENIAN 1983; STERNBERG 2010). In these regions, university spin-offs²⁸ 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 (SHANE 2004). The main assumption is that university spin-offs are more innovative and therefore grow faster than other start-up companies because they benefit from the technology transfer from university (CZARNITZKI/RAMMER/TOOLE 2014).

Yet, this does not necessarily mean that every single university technology leads to a university spin-off which then becomes a global leader. On the contrary, an increasing

²⁷ Best PhD Candidate Paper Award of the 17th Uddevalla Symposium 2014 in Uddevalla, Sweden. An earlier version of this paper is going to be published in BERNHARD, I. (ed.) 2014: *Geography of Growth – The Frequency, Nature and Consequences of Entrepreneurship and Innovation in Regions of Varying Density* (Proceedings of the 17th Uddevalla Symposium 2014). Trollhättan/Uddevalla: University of Trollhättan.

²⁸ For a working definition of university spin-offs see Chapter 5.3.1.

number of empirical studies exist claiming the opposite (ENSLEY/HMIELESKI 2005; NIGHTINGALE/COAD 2011), which is why the focus of this paper is on low growth university spin-offs. For example, empirical evidence on employment growth²⁹ of university spin-offs is rather controversial (HELM/MAURONER 2007). Even in high-tech clusters only very few university spin-offs have a high number of employees and furthermore, employment seems to increase growth only after 10 years on the market (LAWTON SMITH/HO 2006). Especially at mid-range universities outside high-tech clusters, university spin-offs are rather rare entities with sometimes only minimal levels of job creation (DEGROOF/ROBERTS 2004; HARMON et al. 1997; HEMER et al. 2006).

However, there are almost no scientific studies on the reasons for the lack of growth of university spin-offs and thus the arising research question is: Why do most university spin-offs remain small? My analysis is based on qualitative survey data from two German midrange universities in which the majority of university spin-offs creates only a few jobs while the often cited “gazelles” are rather the exception. I carried out a total of 85 semi-structured face-to-face and telephone interviews with academic entrepreneurs from September 2011 to January 2012. The analytical process relied on a content analysis and a theoretically and empirically based construction of types with the help of the qualitative data analysis software NVivo.

This paper is structured as follows: First of all, I describe the conceptual framework which is based on a specific concept of growth phases and research findings on growth willingness and ability (Chapter 5.2). After introducing the data and methods used in this paper (Chapter 5.3), the eight different types of university spin-offs are analyzed addressing ambitious university spin-offs (Chapter 5.4.1), university spin-offs with a lack of growth intentions (Chapter 5.4.2) and impeded university spin-offs (Chapter 5.4.3). Also, possible changes in university spin-offs’ growth paths are thereby approached. Afterwards, I discuss limitations (Chapter 5.4.4). Finally, I draw a conclusion (Chapter 5.5) and derive implications for policy and further research (Chapter 5.6).

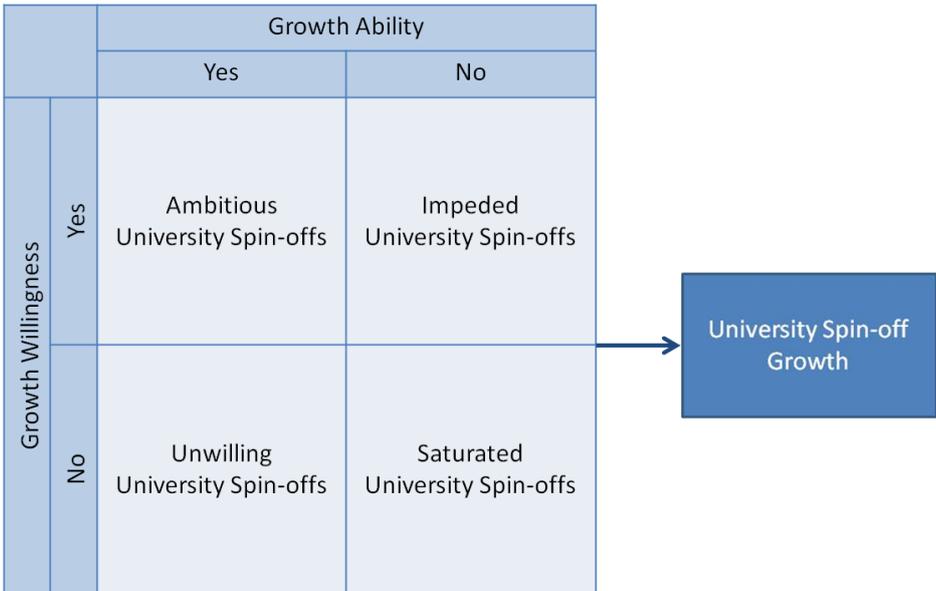
²⁹ Firm’s performance can be measured in many different ways. Common indicators used in literature are survival rate, employment growth, sales growth, productivity and credit rating (HELM/MAURONER 2007). This paper mainly focuses on employment as a measure of performance because it has the most consistent positive correlation with other growth measures and is a key interest among policy makers (DAVIDSSON/ACHTENHAGEN/NALDI 2007; WIKLUND 1998). Furthermore, it is less susceptible to fluctuations and a good indicator for the university spin-offs’ overall assets (GIBCUS/STAM 2012). Nevertheless, these propositions do not apply to all branches equally.

5.2 Growth Ability and Willingness Depending on Growth Phases

The conceptual framework initially considers the combination of university spin-off growth ability and academic entrepreneurs’ growth willingness (DAVIDSSON 1989). These two aspects are then related to a concept of growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007). Finally, I derive two research questions.

5.2.1 Growth Ability and Willingness

As already described in the introduction, it is important to realize that growth does not seem to be the norm for many university spin-offs. The reasons lie in internal factors (e.g. firm and management) as well as external factors (e.g. taxes, legislation, market conditions for product labor and financing), which influence the university spin-off’s ability and academic entrepreneur’s willingness to grow. One should not take the growth willingness of academic entrepreneurs for granted. The academic entrepreneur is not a profit maximizing actor but has rather the freedom of choice (DAVIDSSON 1989; HAYTER 2010). According to Ajzen (1991) many empirical studies in the recent past suggest that the entrepreneurial growth intentions are important for subsequent business growth (CASSAR 2007; DOUGLAS 2013; GUNDRY/WELSCH 2001; HERMANS et al. 2012; STAM et al. 2007; VAN STEL et al. 2010). Four categories are derived by crossing the determinants of growth willingness and ability: ambitious, impeded, unwilling and saturated university spin-offs (see Figure 26).

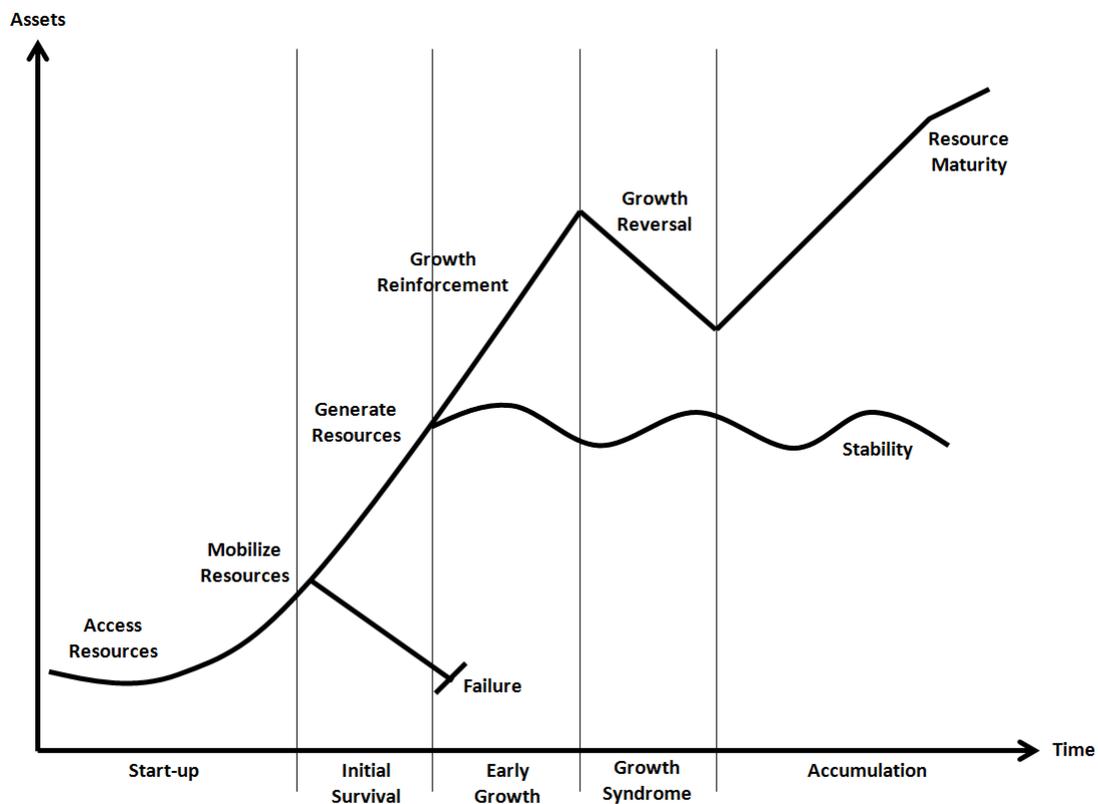


Source: Own illustration following DAVIDSSON (1989).

Figure 26: Crossing Growth Ability and Growth Willingness

5.2.2 The Concept of Growth Phases

University spin-off growth is a process, therefore growth ability and growth willingness should not be understood as being static. The studies mentioned in the introduction investigate university spin-off growth by means of a quantitative, cross-sectional analysis. According to the need for future research, which should *“be driven by theory and methods that reflect the heterogeneity of the phenomenon,[...] treating growth as one phase in an evolving pattern of development”* (DOBBS/HAMILTON 2007:316), I will instead focus on university spin-off development using an evolutionary approach (STAM 2010). Different concepts of how and why firms evolve and develop over time exist (LEWIS/CHURCHILL 1983). Nevertheless, there are typical phases through which the majority of firms go through in their lifecycle (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007), whether they are ordinary firms or university spin-offs. Thereby the growth phases should not be understood as temporally fixed or predictable but non-linear and marked by setbacks (GARNSEY/STAM/HEFFERNAN 2006). Nevertheless, such a concept of growth phases can be used to structure the development of university spin-offs and thereby address growth ability and willingness as explained in more detail below. In the following I mainly focus on GARNSEY’S (1998) concept of growth phases (see Figure 27).



Source: Own illustration following GARNSEY (1998:530) and STAM (2007).

Figure 27: The Concept of Growth Phases

In the startup phase the founder recognizes opportunities, develops a business plan, mobilizes resources and carries out the formal foundation (GARNSEY 1998; STAM 2007). Especially in this very early phase several problems can occur, which impede and delay university spin-off growth. Impeded academic entrepreneurs have troubles facing their business goals due to an unfavorable environment, such as an adverse or even hostile university setting, antipathy or jealousy from superiors or a lack of resources (ERDÖS/VARGA 2012).

Resource mobilization is very dependent on the type of business activity. Especially for university spin-offs which develop products or even create infrastructure, the mobilization of resources can be tough and related to many problems because resource requirements are extensive (DRUILHE/GARNSEY 2004). For example, university spin-offs exploiting research results often do not find external stakeholders so easily because they react more constrained to this kind of university spin-off. Firstly, they need a large team with various competencies which can lead to low sales productivity in the first years. Secondly, standardization and economies of scale for university spin-offs exploiting research results are difficult to achieve (EGELN et al. 2002). As a result, the process of resource mobilization can take years (GARNSEY 1998).

Next a steady transition from the start-up phase to the initial survival phase occurs. The firm generates resources through its productive and commercial activities and is therefore able to survive in the market economy (STAM 2007). In this phase the firm has already built routines, which makes it easier to respond to recurring problems. If a secure market position is achieved a more or less extended stable phase usually follows. Many firms do not go beyond this phase but remain small. This may be caused by a niche market strategy with a simultaneous unwillingness to shift the product range or by a missing growth intention. These firms, which do not want to leave their comfort zones even in the long run, are described as lifestyle companies (GARNSEY 1998; LEWIS/CHURCHILL 1983). Some authors identify academic entrepreneurs who lack growth intentions. MEYER (2003) calls them “entrepreneurial academics” because they do not have the aim to develop a fast growing university spin-off but to engage in research. This is in line with HARRISON and LEITCH (2010), who argue that most university spin-offs in the UK “start small and remain small” because they are “technology lifestyle businesses not dynamic high-growth potential start-ups”. The “classical academic entrepreneur” described in ERDÖS and VARGA (2012) goes in the same direction. The classical academic entrepreneur’s central goal is to extend scientific activity by founding a university spin-off, so that the university spin-off and the academic

work are strongly related to each other. In some cases this results in an unbalanced relationship between university spin-off and university work, so that the university work remains or becomes dominant. Although the study by ERDÖS and VARGA (2012) is based on academic entrepreneur's motivation and does not consider university spin-off growth explicitly, it can reasonably be concluded that university spin-off growth can hardly proceed under these circumstances.

In the early growth phase, new market opportunities are exploited and the product-market share grows. This makes the firm not only survive but grow beyond a certain threshold. Nevertheless, steady growth is rather unusual in the long run. Especially academic entrepreneurs are often associated with ambitious entrepreneurs³⁰ (HEMER et al. 2006), although many empirical studies suggest that only a small minority of university spin-offs has sustained employment growth in the long run (GARNSEY 1998). The effect of growth, especially rapid growth, can simultaneously create growth restraining effects. Firms usually experience periods of decrease or stagnation due to various reasons deriving either from the entrepreneur, the firm or the external environment (STAM 2007). However, growth is sometimes the only way to survive for innovative firms (GARNSEY 1998), as following remarks on arising difficulties show.

In a period of growth reversal, internal as well as external growth pressures can occur. Internal growth pressures develop because resources are released, routines are established, production is set up and staff may be underemployed. As a result, the under-used capacities induce further growth (GARNSEY 1998). By contrast, external growth pressure can derive from external investors, customers or distributors. It also happens that external investors supply financial resources in the hope of superior returns in the future (GARNSEY 1998; STAM 2007). This "*forced evolution*" (LEWIS/CHURCHILL 1983:11) of course can stimulate growth but it can also lead to pressure for short-term profit growth and a demand for immediate payback (GARNSEY 1998; STAM 2007). Once a firm gets bigger, complexity increases of course. In order to avoid decision-making and synchronization problems new leadership patterns or even the delegation of the management task to professional recruits are necessary. However, the introduction of a new leadership can again cause new problems (GARNSEY 1998; LEWIS/CHURCHILL 1983). Other problems, which cause a growth reversal, are the saturation of the niche market and changing conditions like increasing competitions or

³⁰ Ambitious entrepreneurs are defined as entrepreneurs, whose firms had high growth rates in terms of sales or employment in the past and that are expected to grow above normal in future years (HERMANS et al. 2012).

maturing markets. An early adjustment through a shift in the business strategy and an upgrade, renewal or expansion of the product range is necessary (GARNSEY 1998). Furthermore, in times of crisis the loyalty of staff is put to the test, so that valuable knowledge and experiences becomes lost when staff members leave (GARNSEY 1998). All these difficulties and crises discussed above can lead to low growth companies. They remain on a relatively stable plateau on a rather low level in order to avoid further risks related to growth. Only a few firms then regain strength and continue to grow. In this phase, the sale of the company may be an option for some entrepreneurs (GARNSEY 1998).

After a period of growth reversal the firm has to recognize and realize new opportunities and generate surplus resources in order to achieve accumulation. This can happen either under the firm's own resources or through a purchase of or a takeover by other companies. The processes in this phase transform the original identity of the firm (GARNSEY 1998; STAM 2007).

The concept of growth phases focuses on the early phases including typical problems because usually the initial seven years determine the company's growth pattern. Mature phases are not addressed in detail because difficulties in the later phases are quite variable and not sequential. Nevertheless entrepreneurial processes are path dependent, which means that early events and decisions shape a firm's development (GARNSEY 1998).

5.2.3 Developing Research Questions

The theoretical and empirical results discussed above demonstrate that many university spin-offs tend to stay small. Based on the concept of growth phases university spin-offs are investigated in order to identify certain patterns in university spin-off development paths. Thereby not only the lack of growth ability due to phase-dependent difficulties mentioned above is considered. Also, the academic entrepreneur's lack of growth willingness is taken into account, because growth intentions appear to be critical for the future performance of a university spin-off. Based on this conceptual framework the first research question is derived:

- 1. What types of university spin-offs can be identified based on the concept of growth phases in consideration of the academic entrepreneurs' willingness and university spin-offs' ability to grow?*

As the conceptual framework already indicated, the entrepreneurial process is dynamic and the firm has to adapt continuously to a changing environment. Therefore, university spin-offs

types are not rigid, but may change over time. These changes in growth paths are particularly important to comprehend, especially for policy makers. Thus, the second research question is:

2. *What circumstances make university spin-offs change their growth paths?*

5.3 Data and Methods

From the conceptual framework it is obvious that the reasons for a lack of growth are quite complex. The entrepreneurial process is dynamic and a firm has to adapt continuously to a changing environment. These mechanisms can hardly be investigated by quantitative analysis, which would make it necessary to define rigid independent variables (DRUILHE/GARNSEY 2004; KODITHUWAKKU/ROSA 2002). This is why the aim of this paper is to illustrate and understand the complexity of university spin-off growth through qualitative research methods. Qualitative research generally focuses on analytical instead of statistical generalization (MILES/HUBERMAN 1994). Different approaches for collecting and analyzing qualitative data exist (BERNARD/RYAN 2009). I conduct a qualitative content analysis as well as a theoretically and empirically grounded construction of types. I describe the chosen approaches in more detail in the following.

5.3.1 Definitions

Following PIRNAY et al. (2003) and SMILOR et al. (1990) I defined academic entrepreneurs as scientists or students who left a university to start a company or who founded (or co-founded) a company while still affiliated with a university to exploit their knowledge and/or skills acquired at university with 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 (e.g. SMILOR/GIBSON/DIETRICH 1990), I take a broader view of knowledge transfer by including academic entrepreneurs of knowledge intensive service companies, which often arise from the social, human, economic and political sciences (e.g. RAPPERT/WEBSTER/CHARLES 1999). In order to exclude self-employed individuals and freelancers (e.g. doctors or lawyers) from the analysis I only took private limited companies and corporations into account.

I analyze university spin-offs which were founded from 1980 until 2011. The time between leaving a university and the official business formation did not exceed a maximum of three years because this study investigates spin-offs based on university knowledge. The temporal boundary of a maximum of three years is a good compromise. On the one hand I avoid taking entrepreneurs into account, who gained significant knowledge in the private sector

(PIRNAY/SURLEMONT/NLEMVO 2003; WENBERG/WIKLUND/WRIGHT 2011). On the other hand a sufficient time period is necessary for setting up a company, especially in high-tech sectors.

5.3.2 Data Sources and Sampling Approach

A wide range of literature already exists on top universities and regions like Silicon Valley in California, Greater Boston in Massachusetts, or the Research Triangle in North Carolina (SAXENIAN 1983; STERNBERG 2010). In this paper, the cases were drawn from the two biggest universities in Lower Saxony, Germany with regard to the total number of students³¹, the number of students in subjects which are common for university spin-offs³², the number of scientific staff, and research expenditures (KULICKE et al. 2008). The two chosen universities, Hannover and Göttingen, are particularly suitable examples for German universities with a rather weak entrepreneurial support structure located in regions without high-tech clusters (see Chapter 2). At this kind of university individual characteristics and career paths play an important role for university spin-offs.

Since the data on university spin-offs in Germany is far from accurate, the data used in this paper was collected within the framework of a broader research project³³. The current study should therefore also give an overview on university spin-off activities at the two chosen universities. For this reason a more comprehensive approach to data collection was chosen compared to other qualitative studies (BAKER/EDWARDS 2012). In order to identify as many academic entrepreneurs as possible the total sample of university spin-offs for the two universities was composed as follows:

In the first step of data collection I had informal discussions with leaders of the technology transfer offices and employees of different economic development agencies located in the two survey regions Hannover and Göttingen. I also sent letters to the heads of all institutes of both universities asking for information about university spin-offs in order to avoid a bias for the benefit of those university spin-offs that may have used advice on funding and financing matters. Furthermore, I conducted a search operation through the business network XING in

³¹ Leibniz Universität Hannover had 21,478 students and Georg-August-Universität Göttingen 26,381 students in the summer semester 2013 (GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN 2013b; LEIBNIZ UNIVERSITÄT HANNOVER 2013b).

³² These are the MINT subjects (mathematics, computer science, natural science and engineering) and medical science (KULICKE et al. 2008). MINT subjects are comparable to the STEM fields used in English. These include science, technology, engineering and mathematics.

³³ See acknowledgements at the end of the chapter.

order to find any university spin-offs, which had contact neither with the current faculty staff nor with the technology transfer offices nor with 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 searches. In many cases it was not clear if a business was from an academic entrepreneur according to our definition. In total, I obtained a list of 249 university spin-offs. According to the research aim as well as the available time and resources (BAKER/EDWARDS 2012), 143 university spin-offs from this population were asked for an interview. A sampling grid was used to ensure a heterogenic sample structure (BERNARD/RYAN 2009; SCHREIER/NADERER/BALZER 2007). The cases were equally distributed between the two basic categories: students or scientists.³⁴

58 university spin-offs were unresponsive or did not agree to an interview. One could assume that those academic entrepreneurs who did not respond to our contact request, could be either less or more successful. Some may be embarrassed, others could be too busy. As academic entrepreneurs of failed university spin-offs are usually considerably less forthcoming, my study is largely based on university spin-offs which were still on the market at the time of the survey, although a large number of academic entrepreneurs probably does not succeed in establishing and running a university spin-off (GARNSEY 1998). Nevertheless, our sample included a few academic entrepreneurs who failed on the first attempt but start a business for a second time. Also, individuals who are no longer affiliated to the parent university might have been less willing to take part in the interview.

In the third step of data collection, I carried out a total of 85 semi-structured face-to-face interviews (BERNARD/RYAN 2009) with at least one founding member of each university spin-off during the period of September 2011 to January 2012.³⁵ The face-to-face interviews usually took place in the respective company and ranged from 45 minutes to two and a half hours in length. A few academic entrepreneurs were interviewed at neutral places or by telephone due to distance, space or scheduling problems. The vast majority of interviews was openly recorded and directly transcribed. In a few cases a content protocol was written during the interview if the interviewee did not want to be recorded. During the interviews, I asked

³⁴ Although the cases were also equally distributed between the two chosen universities, I did not differentiate the academic entrepreneurs according to their parent university in this study, because this was only relevant for the central research project. For the aim of this present study the parent university is not relevant.

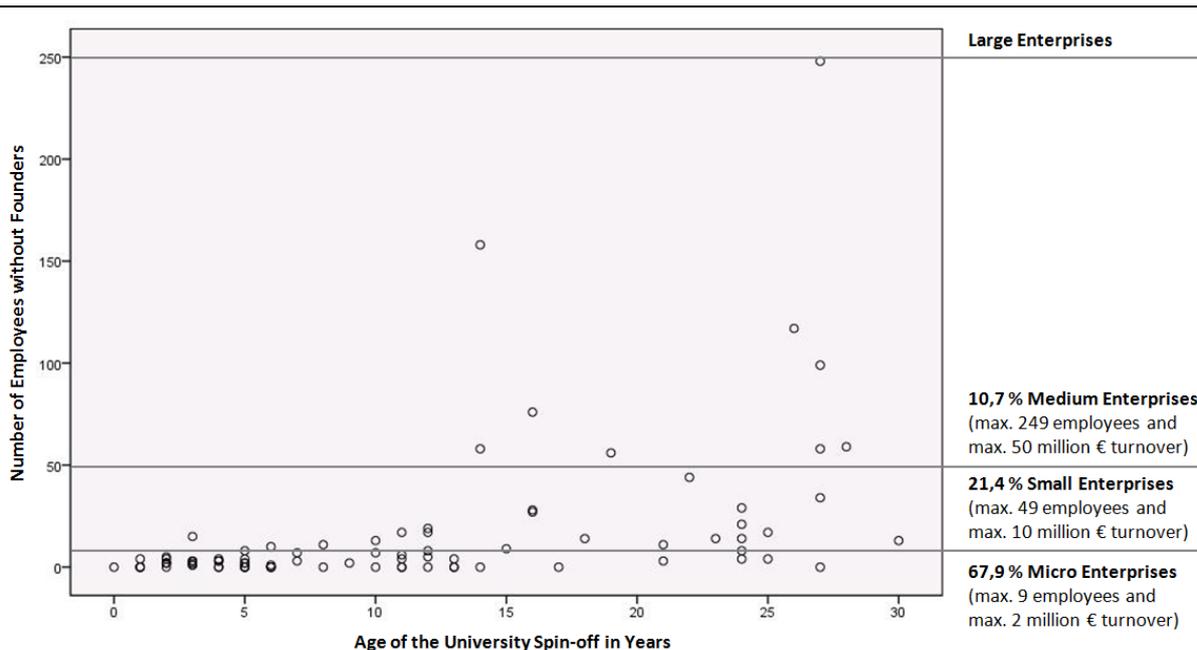
³⁵ All interviews were anonymized for data privacy reasons. Therefore, the interview partners are not listed in the annex.

open-ended questions pertaining to the chronological career path before the university spin-off was founded as well as the phases of preparing, establishing, and developing the university spin-off (GARNSEY 1998; VOHORA/WRIGHT/LOCKETT 2004), as shown in Annex 3. I took field notes during and after the interviews. Furthermore, a post-interview questionnaire (see Annex 4) and information collected from the university spin-off websites and press articles augmented the data.

5.3.3 Data Coding and Analysis

As a starting point for the data coding and analysis the university spin-off sizes, measured by the number of employees, was evaluated quantitatively.³⁶ To measure university spin-off growth, academic entrepreneurs were simply asked for the number of employees in the year of formation and at the time of the interview. Figure 28 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 increases. 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%. This result underlines the question, why most of the university spin-offs stay small, also in this sample. In order to answer that question I take not only university spin-off growth ability but also the academic entrepreneurs' growth willingness into account and analyze the history of each university spin-off in depth.

³⁶ The results of this study are based on university spin-off growth in regard to the 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 (HAYTER 2010; HELM/MAURONER 2007).



Valid cases: 85. One case corresponds to one university spin-off. Number of employees is based on full-time equivalents in the year 2011.

Source: Own illustration. USO survey 2011. Categorization of enterprises in accordance with the Federal Bureau of Statistics (2013).

Figure 28: University Spin-off Size

In a second step I establish university spin-off types (KLUGE 2000). Based on the conceptual framework, I develop an attribute space and conduct a content analysis (MAYRING 2000) with regard to the chosen attribute space for all interviews. The combination of university spin-off growth ability and academic entrepreneurs' growth willingness enables the identification of four basic types of university spin-offs: ambitious, impeded, unwilling and saturated university spin-offs (see first to third column in Table 6). I assigned each university spin-off to one basic type.

In a third step I identified empirical regularities and content connections within the four basic types with regard to the university spin-off growth phases (KLUGE 2000). In this way, I assigned 68 university spin-offs³⁷ in the sample to eight different homogenous subtypes (see fourth and sixth column in Table 6).

The findings of these subtypes augment existing theoretical considerations. Finally, according to my second research question the dynamics in the growth phases for each type were analyzed.

³⁷ University spin-offs founded in 2008 or later were not taken into account to avoid bias. This leads to a reduction of cases from 85 to 68 university spin-offs.

The whole analytical process was supported by the qualitative data analysis software NVivo and included several feedback loops by which the categories and types were revised carefully (MAYRING 2000).

Table 6: Coding Frame for University Spin-off Types

Basic Types (based on growth willingness and ability)	Description	No. of cases	Subtypes (based on growth phases)	Description	No. of Cases
Ambitious University Spin-offs	High growth rates in the past. Expansion is desired and presumable (HERMANS et al. 2012).	19	High Flyers	Increase in employees of more than four persons per year in average for more than ten years; concrete goals for further expansion.	5
			Standards	Exemplary growth path (GARNSEY 1998); increase in employees of one to three persons per year in average for more than four years; concrete goals for further expansion.	14
Unwilling University Spin-offs	Low growth rates in the past. Expansion is not desired explicitly, although it might be possible. The founders prefer a small university spin-off.	28	Life-Stylists	Increase of less than one employee per year even after many years on the market; almost no growth intention for independence reasons (DOUGLAS 2013; GARNSEY 1998; HARRISON/LEITCH 2010).	11
			Entrepreneurial Academics	Firm size with no more than four employees even after many years on the market; almost no growth intention for academic career reasons (ERDÖS/VARGA 2012; MEYER 2003).	5
			Hesitators	Increase of less than one employee per year in average; firm size of less than 14 employees even after more than ten years on the market; almost no growth intention because of risk aversion.	12
Impeded University Spin-offs	Expansion is desired but the university spin-off cannot grow currently due to reasons, which can be found in the academic entrepreneur, the university spin-off or the external environment (ERDÖS/VARGA 2012; HELM/MAURONER 2007).	21	Survival Artists	Never started growing although growth intention exists; no employees, even after many years on the market; uncertain to bad future prospects; miscalculation of the business activities from the beginning.	6
			Late Bloomers	Firm size with up to ten employees; four to eight years on the market; concrete goals for strong growth in the next years; extended startup and initial phase due to long research and development needs or problems with the regulatory framework	7
			Choked	After being on the market successfully, further growth impossible because of external reasons classified as problems from the demand and supply side.	8
Saturated University Spin-offs	Theoretical category. It is difficult to assign cases to this category empirically, because if entrepreneurs do not want to grow the question is no longer relevant if it is theoretically possible.				0

Note: One case corresponds to one university spin-off. University spin-offs founded in 2008 or later were not taken into account to avoid bias.

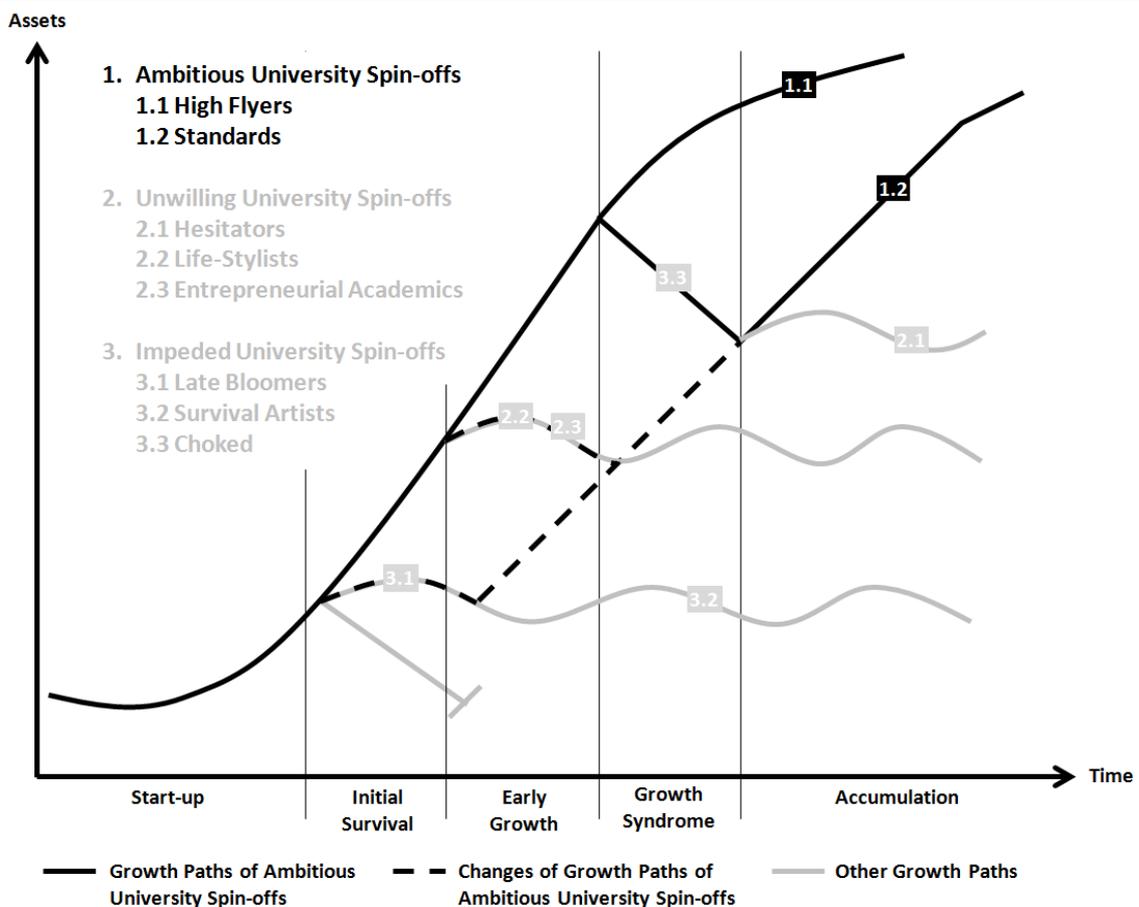
Source: USO survey 2011

5.4 Empirical Results University Spin-off Growth Types

In the following chapters the generated university spin-off types are discussed in detail. Firstly, in order to answer the first research question, each university spin-off growth type is presented by describing its share and special characteristics. Secondly, according to the second research question dynamics are described by demonstrating concrete examples in which growth paths have been changed.

5.4.1 Ambitious University Spin-offs

Ambitious firms have high growth rates in terms of sales or employment in the past and are expected to grow strongly in the future (HERMANS et al. 2012). Figure 29 gives an overview on the growth paths of the subtypes of ambitious university spin-offs including possible changes in types. Less than one-third of the cases in my sample is well established on the market and/or has high growth rates with promising future prospects and a high growth intention.



Note: To ensure anonymity, only schematical growth paths are displayed.

Source: Own illustration following GARNSEY (1998) and STAM (2007) supplemented and adjusted by USO survey 2011.

Figure 29: Growth Paths of Ambitious University Spin-offs

Around one fifth of the university spin-offs in my sample belong to the type of standard university spin-offs, which comprises the largest subgroup in my sample. Usually this stadium is only achieved earliest after four years. Standard university spin-offs are characterized by a moderate increase in employees in the past years of one to three persons per year. They experienced a development which is quite comparable to the exemplary growth path described in the literature review (see Chapter 5.2.2): start-up and initial survival followed by early growth and periods of growth reversal, and ultimately achieving maturity. After overcoming periods of growth reversal, standard university spin-offs look forward to the future with confidence. They plan to open up new market potentials, employ more staff, move to larger premises or add new buildings, and think about company shares.

In addition to standard university spin-offs, only a handful of university spin-offs in my sample is extraordinarily large and belongs to the type of high flyers. High flyers are characterized by an increase in employees of more than four persons per year in average for more than ten years. Furthermore, even after many years on the market they still have concrete goals to further expand the university spin-off, as this academic entrepreneur reports: *“We will probably duplicate the number of employees in 2013/2014; and the business plan provides for an increase of about 100 employees in 2017/2019, if everything proceeds according to desire.” (USO41).*

Sustainable high flyers are rare. Although it is true that some university spin-offs have a huge increase in employees in the first years on the market, especially in the service sector, it should be noted that saturation is usually reached quickly and the university spin-off is then quite stable. A good example of this is the following very ambitious beginner with high growth rates in the past. When considering future prospects and growth intention it is obvious that he does not want to expand his company much more: *“I have a vision of a consulting company with 10 to 15 qualified employees, with whom I can work on exciting projects. It is also a size, with which one can manage good mandates. I would like to establish my company further on the market.” (USO46).* Also the reverse case was reported in the interviews. Some high flyers did not have the goal of a high growth university spin-off at the beginning, as this interviewee says: *“The technical interest was in first place and was to implement something technologically on one’s own. The firm was certainly founded because of a technological interest. It was not the purpose to found a firm with 120 employees.” (USO65).* Later on and with beginning success this academic entrepreneur’s attitude changed and he grew into his new role. *“One year ago another firm took over our firm due to the fact that we have a very*

rare technology and we had strong growth intentions. The firm should grow further and we are working on that now. We plan that the firm should have the double size during the next five years. The goal is to employ around 200 persons and to generate the respective turnover. We developed some new products and we have to go in that direction.” (USO65). The examples confirm the importance of the academic entrepreneur’s growth intention. The data shows quite clearly that university spin-offs of academic entrepreneurs with a lack of growth intention do not grow.

Although the examples above show the importance of academic entrepreneurs’ growth intentions, it is not the only factor which is crucial for sustainable high growth. When we asked the high flyers for their factors of success they highlighted the importance of high quality products, a permanent willingness to adjust business strategies and product innovations according to market changes in the, also in close contact with customers and possibly with the help of external experts. One high flyer outlines the growth paths of his university spin-offs as follows: *“Product decisions were essential for our business development. The initial product development was completed after two years. This first product multiplied the turnover for up to five years. It made the firm move forward. Then a certain kind of saturation was achieved and we could see that the R&D sector was limited. At that moment we made the decision for a new business strategy and changed the direction. Then we made a very important decision to finance the growth more sustainably by including an associate company which handled 40 % of our firm. This enabled us to grow further, because you cannot let a firm grow in such a short time on the basis of profits only. We used to finance our firm by means of credits which reached a worrying amount. If things had gone wrong, we would have had to bail out the credits personally. We should have done this step much earlier. It is better to have a small share in a well-financed firm than a big share in a badly financed firm.” (USO65).* This quote shows quite clearly that a good product in conjunction with adjustments of the business strategy and financing structure leads to sustainable growth. At a certain point in university spin-off development some of the high flyers in my sample were partly sold to other big companies and/or went public.

It also seems to be very important for university spin-offs to become increasingly independent from a university. In the beginning a close contact to a university may be beneficial, but in the long run university spin-offs must be able to survive on the market without the help of a university or its funds. The university spin-offs have to react to changes in the market and environment, which makes it necessary to act independently from a university. There are also

some academic entrepreneurs, who initially had the goal of becoming high flyers, but they failed at the end because of miscalculations and the external environment. One academic entrepreneur reports for example: *“We started with four founders. The original plan was to become a really big company of 30 to 40 employees in five to ten years. Due to the fact that we could not meet the expectations, two founders gave up.”* (USO19). The reason for the failure was that they employed an increasing number of highly skilled staff and financed them through funds in the early growth phase. When the funding ran out, the university spin-off had to survive with only its profits for the first time. At the same time there was a crisis in the respective sector. This led to a crisis in the university spin-off and the dismissal of an employee. After that the sector experienced a real boom which was highly beneficial for the growth of the university spin-off. Nevertheless, the academic entrepreneurs still prefer cautious growth: *“You have to be careful with expansion. I would say better to grow carefully. You have to be careful with the contracts and that you do not hand over the reins of power. We kept our minds on our share of votes, so that we could still inhibit decisions.”* (USO19). Although this university spin-off has not met the goal of becoming a high flyer, it belongs to the category of standard university spin-offs now at least.

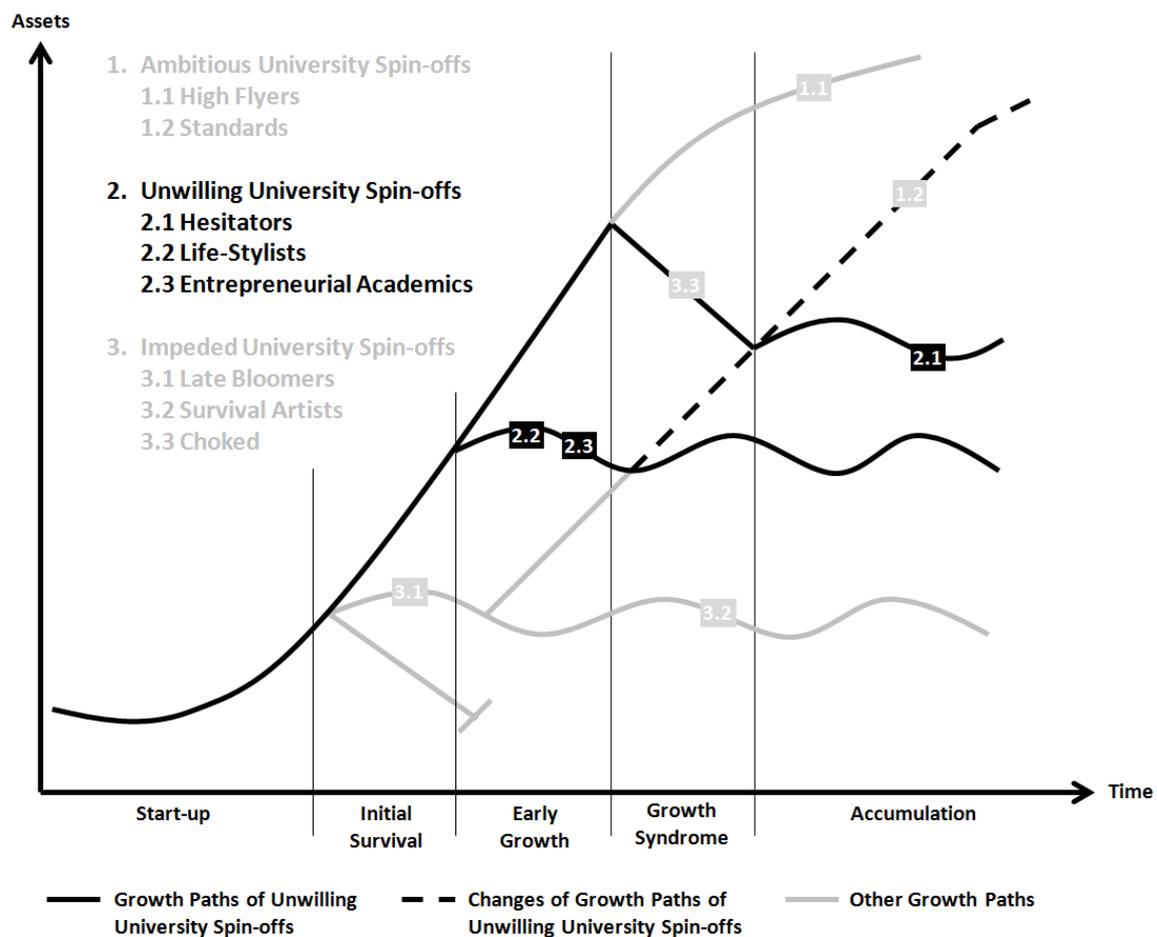
The results show that ambitious university spin-offs emerge not only because of high quality products at the right time and continuous adjustments in business strategy and financing structure. It is also the academic entrepreneur who should be willing to lead a high growth university spin-off. All these factors certainly increase the chances of becoming a high flyer, but this is far from being predictive because the environment and the academic entrepreneur's growth intention can change over time.

5.4.2 Unwilling University Spin-offs

Around 40 % of the university spin-offs in the sample are characterized by a lack of growth intention and as a result, by low or even no growth. These academic entrepreneurs do not address growth due to different motivations, which are discussed in more detail in the following. Figure 30 gives an overview on the growth paths of the subtypes of unwilling university spin-offs including possible changes in types.

The first type of university spin-off with a lack of academic entrepreneur's growth intention is the lifestyle university spin-off (labeled number 2.2 in the figures) (GARNSEY 1998; HARRISON/LEITCH 2010). Academic entrepreneurs of lifestyle university spin-offs want to stay small because they have a strong technical interest and want to put their own creativity into practice. They do not want to undertake managing tasks only, as it would be the case if

they had a big company. The maintenance of independence is of central importance in this respect (DOUGLAS 2013). Lifestyle university spin-offs record an increase of less than one employee per year. The majority of lifestyle entrepreneurs in the sample do not want to take responsibility for many employees because employees are rather seen as a burden. Many of these types of entrepreneurs therefore rely on freelancers. In this way, they keep their university spin-off flexible. *“Our credo is a little bit to keep the enterprise as small as possible, but to offer very specific products of high quality.”* (USO20).



Note: To ensure anonymity, only schematical growth paths are displayed.
 Source: Own illustration following GARNSEY (1998) and STAM (2007) supplemented and adjusted by USO survey 2011.

Figure 30: Growth Paths of Unwilling University Spin-offs

Nevertheless, under certain conditions lifestyle entrepreneurs may expedite university spin-off growth, as one example in my sample shows. The academic entrepreneur used to be a lifestyle entrepreneur although he now has a relatively big company after many years on the market. He founded the university spin-off because of a strong technical interest and even broke off his university studies for the company. He never had the goal to lead a bigger company though, as it is the case today. *“I have almost never produced. I have always sold my ideas to*

other people, who produced them and gave me money for it. That I possess all this now that is not what I wanted. Because I am not an entrepreneur in the classical sense, who is concerned to achieve a turnover in the millions and heaven knows what; and the bigger the factory the better. I am the inventor. I am the tinkerer. I like to introduce myself to others in this way. I have my doctors. I have five physicians who all have a doctorate. I did not even finish university. That is also feasible.” (USO12). However, it was a slow process and at a certain point in time he employed a person for the managing tasks, so that the university spin-off continued to grow but he was still able work on the technical innovations (see dotted line in Figure 30).

The opposite is also possible. There are lifestyle entrepreneurs in my sample that belonged in the category of high flyers during their initial years. They had a huge increase in employees in a short time until they reached a certain threshold of usually five to nine employees (DAVIDSSON 1989). Then they stopped growing and kept the university spin-off size stable from then on. Usually this type of academic entrepreneur is in the service sector, where a critical mass is reached relatively quickly and endless growth is not worthwhile. The same is true for entrepreneurial academics, who are analyzed in the following.

The second type of university spin-offs with a lack of academic entrepreneur’s growth intention is actually a very specific subtype of lifestyle university spin-offs called entrepreneurial academics (labeled number 2.3 in the figures). Similar to lifestyle university spin-offs they are characterized by almost no growth intention and a firm size with no more than four employees even after many years on the market. They differ from lifestyle university spin-offs only in terms of the motivation for the lack of growth intention. For these academic entrepreneurs the university career is actually the first choice, which is why they are called entrepreneurial academics (ERDÖS/VARGA 2012; MEYER 2003). The university career and the university spin-off are symbiotic with each other. They view the university spin-off as an attractive possibility to finance their subsequent university career or to gain a good reputation as a university professor. They never plan to be a full-time entrepreneur and leave a university because they prefer to do research and teaching, 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. I still write scientific studies here.” (USO63).* He founded a university spin-off right after his graduation and continued his academic career. In engineering, science professors usually start up a business because they can improve their reputation and still continue research and teaching this way.

One professor says: *“I could not be a good university professor without the university spin-off.”* (USO34). Obviously, in these cases the university spin-offs are a means to an end and will hardly become big companies.

It is more often the case that academic entrepreneurs pursue a university career and have a university spin-off at the same time only in the initial years. In many cases, this ends up in an unbalanced relationship, where either the one or the other prevails (ERDÖS/VARGA 2012). This is usually a gradual process where at the end the academic entrepreneur faces a decision due to time constraints or university demands. Many academic entrepreneurs prefer the university spin-off then and terminate their university career. *“I started the PhD and I stopped because I found the topic fruitless and the firm was gathering momentum at the same time. Then I decided that the firm is more fun than counting worm bristles.”* (USO13). When the academic entrepreneur starts to lead the university spin-off with a full commitment, growth is usually stimulated (see dotted line in Figure 30).

The third type of university spin-off with a lack of academic entrepreneur’s growth intention is the group of hesitators (labeled number 2.1 in the figures). Hesitators are characterized by low growth, determined as an increase of less than one employee per year in average. The largest university spin-off in the category of hesitators in my sample employs 14 employees at the most even after more than ten years on the market. Similar to the two types analyzed before, hesitators also do not want to grow rapidly. *“We want to grow under our own steam. Well, not growth as an end in itself, but as long the situation admits it and we find appropriate employees, I don’t mind, if we have one more every year.”* (USO07). In contrast to lifestyle entrepreneurs or entrepreneurial academics, hesitators act this way because they are careful. This attitude can be part of the academic entrepreneur’s character like this academic entrepreneur admits: *“I am not willing to take risks. We have never borrowed money. We finance ourselves with the cash flow. [...] Thus one could almost say I am averse to risks. I also have a risk averse strategy for the firm.”* (USO24).

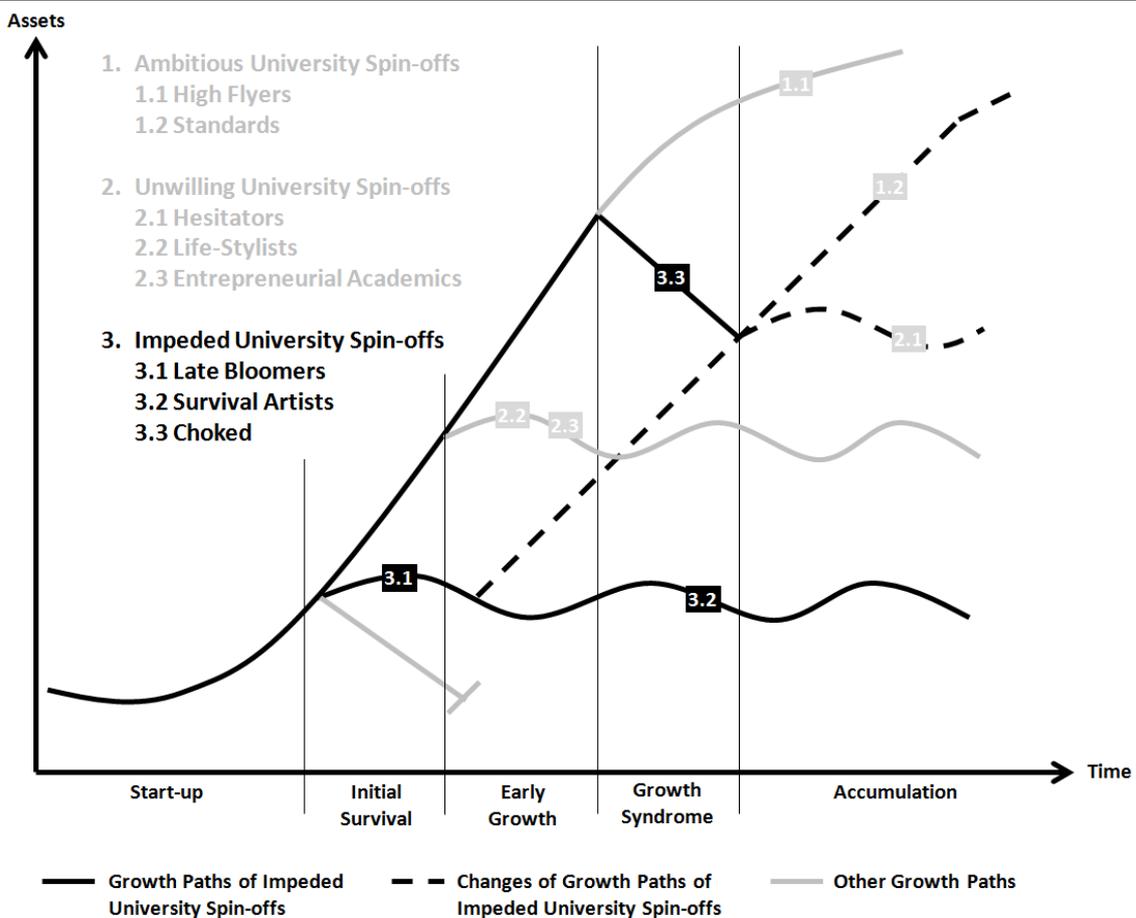
Hesitators may not always have had low growth. Their hesitation can also result from bad experiences in the past, which makes the academic entrepreneurs hesitant regarding growth (GARNSEY 1998). Some university spin-offs were experiencing the economic crises at the time of the interviews. They had felt the direct effect of the global recession and were still hesitant regarding future growth. Also, miscalculations are problematic. In one case the external pressure from an investor was the reason for too rapid growth, as also described in GARNSEY (1998) and STAM (2007). This pressure led to a miscalculation of the economic

situation of the university spin-off. At a certain point this made it necessary to reduce the number of employees significantly in order to survive. Nowadays they are far more cautious, as one academic entrepreneur reports: *“The expansive model did not turn out to be manageable. If we had grown organically, we would have been at the same point today probably, but everybody would have been much better off. However, we had been advised badly. This idea of making a big thing was put in our heads. Here is the money and get going! [...] Finally the philosophy is that we want to grow organically. That means, only to an extent which we can handle. We want to make use of bank financing as little as possible and only to an extent, which we are able to overlook and understand.”* (USO18).

The three types of university spin-offs analyzed above show that a lack of growth intention can result from very different reasons. It can be the case that the academic entrepreneur prioritizes a technological interest or joy of his own creativity (“lifestyle university spin-offs”) or university work (“entrepreneurial academics”). Also a strong risk aversion can be the reason (“hesitators”). It is obviously identifiable that a lack of academic entrepreneur’s growth intention most likely results in a lack of growth. However, the inversion of the argument is not true as the following types of impeded university spin-offs show.

5.4.3 Impeded University Spin-offs

Another reason for low growth and uncertain or bad future prospects can be that the university spin-off growth is impeded by different reasons, which can be found in the academic entrepreneur, the university spin-off or the external environment (ERDÖS/VARGA 2012; HELM/MAURONER 2007). These obstructions can happen at any time during the university spin-off development. At the time of the interviews almost one third of the university spin-offs in the sample had been impeded in different growth phases and for different reasons. This result is quite alarming. By means of a more thorough investigation of the reasons and circumstances the situation may be changed and what could help. Three different types of impeded university spin-offs could be identified and are analyzed in more detail in the following. Figure 31 gives an overview on the growth paths of the subtypes of impeded university spin-offs including possible changes in types.



Note: To ensure anonymity, only schematical growth paths are displayed.

Source: Own illustration following GARNSEY (1998) and STAM (2007) supplemented and adjusted by USO survey 2011.

Figure 31: Growth Paths of Impeded University Spin-offs

The first type of impeded university spin-offs are choked university spin-offs (labeled number 3.3 in the figures). They are usually impeded by external reasons after being on the market successfully for many years and therefore cannot continue growth. The reasons can be classified as problems from the demand and supply side.

From the supply side a forthcoming retirement and the inability to find an appropriate successor hinders further university spin-off growth. It can happen to all types of university spin-offs but of course especially to older academic entrepreneurs, who either were already on the market for many years or founded the university spin-off at an advanced age. Concerning the branch usually university spin-offs with a high amount of tacit knowledge and academic entrepreneurs with outstanding reputations, usually found in the scientific service sector, are affected. *“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 this better than I do, the people expect me to be there. Much depends on my image and the whole construct. I think it will continue quite well as long as I am still fit.” (USO68). This fact is a severe uncertainty factor for long-term university spin-off growth, which I have noticed several times in my interviews (see dotted line in Figure 31).

Also, some entrepreneurs report of the difficulty in finding adequate employees. *“We have already poured the fundament for an expansion ten years ago. The goal is growth. The problem is to find executives who support the growth. That is finally the issue. There are too few qualified people in our sector and not enough staff as far as methodological know-how is concerned. From the market potential side we could have a capacity of 200 men for 800 years. I have calculated it once.” (USO55).* Oftentimes the shortage of qualified employees arises from changes in the parent university and the institute the university spin-off came from. It happens that a professor leaves or the institute is closed. These events are oftentimes an important reason for founding a university spin-off. Due to the fact that these types of university spin-offs have a high knowledge transfer from the university which is very specific it becomes difficult to find adequate staff. Sometimes academic entrepreneurs respond to this problem by lecturing at a university in order to qualify future staff themselves. In another case the academic entrepreneur waived growth because it is too costly for him to qualify further employees. It would take him five years to train an employee.

From the demand side, political decisions and social changes can lead to a decreasing market demand. *“We have only a few competitors but the market is breaking away, because my main customers have to close due to a political decision. Therefore we have almost a unique selling proposition at the supply side but our market is breaking away. This fact forces us to reconsider our business model.” (USO14).* This shows that political decisions and social changes can not only be a source for increasing university spin-off growth as discussed in the previous chapter but in other cases they can even hinder further university spin-off growth.

Also, some entrepreneurs complain about increased competition especially with larger companies and Chinese companies. *“We are in a phase in which Asia picked up the technology, which had good profit opportunities in Europe and worldwide, and Asia already overtook us. The biggest competitors are located in China and complicate our lives. It is very difficult to remain competitive with our products. That means the business development in terms of profit situation has declined during the last five years.” (USO39).*

The second, very typical type of impeded university spin-offs are late bloomers (labeled number 3.2 in the figures). In contrast to choked university spin-offs, late bloomers are

university spin-offs, which have an extended startup and initial phase. They are still in the early phase of business development although they are already four to eight years on the market. They employ up to ten people but they have concrete goals for strong growth in the next years. This kind of entrepreneur usually founded high-tech university spin-offs which exploit concrete research results and have high ambitions for the future (see dotted line Figure 31). However, they are impeded from reaching their goal due to different reasons.

Late bloomers need high investments and a long time for research and development. *“We began the product development in 2005 based on a public contract and now in 2011 we have entered the market. It took us quite a while, but it was because of the development efforts which have taken a long time, and the available resources. If we would have had more resources, we could have implemented it better.”* (USO28). Furthermore, they need a large team which contributes various competencies. Therefore, the sales productivity is quite low in the first years. Also, standardization and economies of scale for exploitation spin-offs are difficult to achieve (EGELN et al. 2002; GARNSEY 1998).

Some other late bloomers in my sample have severe problems with the regulatory framework which caused severe setbacks and delays. A late bloomer reports: *“After we had finished the product we had to register it. The registration took us six months. Afterwards we had to wait for the batch release for another three months, although we had the finished product already in our hands. We could have sold it already but we were not allowed to. It was a really slow procedure and it is still slow nowadays. These are the legal provisions in Germany. Since it was our first product we also made small mistakes which made it necessary to make some modifications to the product. The official regulations in our branch are very strict. It drove us almost into insolvency at that time. After nine months we were able to bring the product onto the market and the orders came in. We had to produce a new batch, but we had to wait for the batch release three months again. Only after that we were allowed to sell the next batch. This is very difficult for us because our products have a durability of 18 months only. Moreover, the whole thing must be pre-financed.”* (USO09).

There is one untypical case in the sample of a much delayed late bloomer. After almost a quarter century on the market the academic entrepreneur has changed his business concept. He used to be a rather hesitant entrepreneur but now he strives for fast growth in the next two years. *“We have developed a new concept. We have a very stable firm with a very low and steady growth rate and a good position on the market. And now we want to make use of this to make completely new things. We want to double the number of employees in the following one*

or two years.” (USO31). He looks optimistically into the future because the competitors are going out of business so that he will soon be the only provider.

Generally late bloomers have promising business ideas. They have not grown that much in their initial years but they have a high growth intention. However, they experience important crossroads: Either they develop to university spin-offs with high growth in the following years (see dotted line in Figure 31) or they are at risk to become survival artists, if they do not overcome their obstacles. The transitions are fluent.

Survival artists started small and remained small (labeled number 3.1 in the figures). In contrast to the type of late bloomers, their future prospects are uncertain to bad. They never started growing and have no employees, although they have been on the market for many years, because they usually miscalculated the business activities from the beginning. This distinguishes them from choked university spin-offs, which were once bigger and suffer from a crisis. In contrast to entrepreneurial academics and lifestyle entrepreneurs survival artists want to grow but they cannot.

In some cases the reason can be found in the quality and handling of the products like this academic entrepreneur of a high growth university spin-off has observed during his time at university: *“I see this quite often, when software is developed at a university and people say: This can be sold. But for software, which I want to sell, I have to do significantly more to make it really fool-proof and to make the handling in such a way that a layman can use it.”* (USO65).

In other cases not the quality or design of a product is bad but the profitability and sustainability of demand is overestimated. Some founders have invested a lot of time in the development of their product, which was not in demand in the desired extent in the end. The initial demand of one single industry partner, which can actually be a good start, can lead to a misjudgment of market potential, which is revealed in the business development after the first order, when subsequent orders of other customers fail to appear. An academic entrepreneur in the sample observed this in his environment: *“If one starts a firm out of university, with something one is well versed with and one notices, that has customers, it still can be that the demand is covered after a few years. If one did not then try to broaden one’s product range at the same time, the firm vanishes with the vanishing demand.”* (USO60).

A few survival artists have misestimated the expense of some projects at the beginning due to a lack of experience. They reported of a non-compliance with important projects or time limits. This in turn led to an order cancellation from the customer side and severe image

damage in a few cases. Due to the fact that this happened at the beginning it is difficult for the university spin-offs to recover. They struggle to survive.

The three types of impeded university spin-offs analyzed above provide an insight into the underlying reasons in different growth phases. Impedances can lead to an extended startup phase, although the university spin-off wants to grow rapidly (“late bloomers”). Obstructions can also lead to a total suspension of growth, although the original business goal was growth so that they struggle to survive on the market over years (“survival artists”). Also, university spin-offs, which have been on the market for many years and have grown in the years before can be affected by obstructions (“choked”).

5.4.4 Limitations

Although the present empirical study contributes to current research, certain limitations need to be considered, which are addressed in the following. The results are based on a sample within the German context, and both universities are located in the same federal state with comparable environments. Despite several reasons justifying this approach (see Chapter 5.3), it should be noted that one must use great caution in transferring the results to other regions or countries.

The study is partly based on an ex-post evaluation. There is a risk that some outcomes are assigned to circumstances that did not in fact exist at that time. However, current growth intentions and number of employees were reported at the time of the interview in order to reduce this memory bias.

Furthermore, I only spoke to the academic entrepreneurs, so that the findings only show their subjective opinion. The academic entrepreneurs therefore might tend to blame other people or external circumstances for missing university growth.

Finally, it should be noted, that the category of unwilling university spin-offs might be overrepresented, because university spin-offs, which neither want to nor can grow could not be identified, so that these cases now belong to the category of unwilling university spin-offs.

5.5 Conclusions and Contributions to Literature

The aim of this paper was to qualitatively investigate why many university spin-offs remain small. By crossing academic entrepreneurs’ willingness and university spin-off ability to grow (DAVIDSSON 1989) four basic types of university spin-offs were derived: ambitious, unwilling, saturated and impeded university spin-offs. Against the backdrop of the concept of

growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007) I furthermore identified eight different subtypes of university spin-offs: ambitious, standards, life stylists, entrepreneurial academics, hesitators, late bloomers, choked and survival artists.

According to my first research question, the results show quite clearly that ambitious university spin-offs do exist, that have continuous growth and are well established on the market. However, the majority of university spin-offs belong to the category of micro and small enterprises. They either lack academic entrepreneurs' growth willingness or are impeded by reasons, which can be found in the academic entrepreneur, the university spin-off or the external environment (ERDÖS/VARGA 2012; HELM/MAURONER 2007). About 40 % of the academic entrepreneurs is unwilling to grow. This can result from a prioritization of a technological interest and the own creativity ("lifestyle university spin-offs"), the university work ("entrepreneurial academics") or a strong risk aversion ("hesitators"). It is obviously identifiable that a lack of academic entrepreneur's growth intention most likely results in a lack of growth. Almost one third of the university spin-offs in my sample look towards an uncertain to bad future, because they are impeded. Impedances can lead to an extended startup phase ("late bloomers"), a total suspension of growth ("survival artists") or an interrupted growth path ("choked"). In this way, the present study confirms the hypothesis on small businesses of DOBBS and HAMILTON (2007), as it comes to the conclusion that also university spin-offs are quite heterogeneous regarding their growth paths, although they even descend from two universities located in the same federal state with comparable environments.

The types identified are rather temporal than rigid and partly dependent on the phases in the growth paths. According to my second research question, the data shows that certain internal and external events can cause a change of type. Just to mention two examples, an initial ambitious university spin-off may become choked because of too rapid growth on the pressure of an external investor. As a result, the academic entrepreneurs may become more hesitant. As a second example, lifestyle entrepreneurs may become more ambitious when they get personnel support who is responsible for the management tasks. My results show that only if both the growth ability and willingness are met the university spin-off will grow.

The contribution of this study to literature is a deeper knowledge on the university spin-off growth process. According to the need of future research articulated in DOBBS and HAMILTON (2007) as well as NICOLAOU and BIRLEY (2003), this study reflects the heterogeneity of university spin-off growth and considers the evolutionary perspective. In contrast to purely economic studies (BAUMOL 1968), growth is not only understood as a consequence of an

economic process but also a personal and social process. In this way, this study augments the existing concepts of growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007). Furthermore, although some studies on the different types of academic entrepreneurs and university spin-offs exist (ERDÖS/VARGA 2012; HELM/MAURONER 2011; NICOLAOU/BIRLEY 2003) they have hardly been systematically investigated and connected with each other in literature. The comprehensive generation of university spin-off types in this study reveals very specific growth paths. Thus, the results of this study contribute to establishing academic entrepreneurship as a separate field of research (DJOKOVIC/SOUITARIS 2008).

5.6 Implications for Policy and Further Research

Academic entrepreneurs determine to a great extent the growth path of the university spin-off. Appropriate support should be orientated towards both the university spin-off's ability to grow and the academic entrepreneur's willingness to grow. Furthermore, the support should also be adapted for the respective phase in a university spin-off's life cycle. It is important to figure out the reasons behind missing abilities and willingness to grow because a modification of the relevant inhibiting factors can have a significant impact on university spin-off growth. In this way, it is possible to identify different types of university spin-offs and support them appropriately, for example by giving financial support or legal advice at "late bloomers" or by liaising "life stylists" or "entrepreneurial academics" with managers.

However, at this point regional policy makers and universities should think about whether the aim of supporting university spin-offs should be the enhancement of growth at all. The regional effects of small university spin-offs should not be disregarded. Small innovative university spin-offs are also very valuable because they contribute to the regional economic diversity for example (COHEN/KLEPPER 1992). 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 for the region and for the university. Especially in the German context, this is of particular importance because German universities usually do not acquire shares in the university spin-offs and do not receive any financial benefit (HEMER/DORNBUSCH/KULICKE 2010). This paper is also designed to encourage a scientific and political debate in Germany on the benefits of university spin-offs for universities and regions apart from financial returns and job creation.

Supposing that knowledge transfer is an important aim of supporting university spin-offs (PHAN/SIEGEL 2006), the cases in my sample show that small university spin-offs tend to have a stronger relationship to the parent university. The reasons lie in the higher dependency on the knowledge transfer and, in many cases, that the academic entrepreneur works part-time in his spin-off as well as at the university (JAIN/GEORGE/MALTARICH 2009; NICOLAOU/BIRLEY 2003). Further research should therefore look at self-employment as a part-time job for scientists. This phenomenon has been almost neglected in literature so far, although it might represent an untapped potential for the university and the region.

Last but not least, one should be aware that growth can also raise problems as some cases in my sample prove. Finally the question arises whether it is perhaps better to grow in a safe and sound manner than quickly and dirtily in the long run (HEMER et al. 2006).

Acknowledgements

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6 Conclusions

This dissertation investigates certain aspects related to academic entrepreneurs and the growth of their university spin-offs. In my approach, academic entrepreneurship is regarded to be a continuous process while the act of university spin-off foundation is understood as being part of an individual's very specific career path. Which career path a person chooses is influenced by his/her career attitudes. For academic entrepreneurs, the time at a university constitutes a major element of their careers. The career at a university in turn influences the academic entrepreneur's human capital, role identity, university status, and resulting entrepreneurial growth intentions. This supplementing perspective allows analyzing the links between the university, the academic entrepreneur and university spin-off development. The findings contribute to the existing literature and result in some general recommendations for policy. Overall the results imply that the relationship between academic entrepreneurs and university spin-off growth is more complex than assumed by most previous studies in this field. This final chapter firstly discusses the main results of the three core papers and their contributions to literature. Secondly, implications for future research are made. Finally, policy implications regarding the encouragement of university spin-off activity at the universities and the encouragement of university spin-off growth are outlined.

6.1 Contributions to Literature

Overall, this dissertation explains the diversity of the academic entrepreneurs, which is rooted in their different attitudes, careers and growth intentions. Academic entrepreneurs are not necessarily profit maximizing performers, as it is often expected in economics (BAUMOL 1968). My results reveal that their careers at university form their role identity which in turn is important for their growth intentions and resulting university spin-off growth. The creation and development of university spin-offs should therefore be understood as an event in a career which is path dependent. Especially in regard to the different types of university spin-offs, a generally optimistic attitude towards university spin-off growth does not seem to be justified.

Despite the diversity of academic entrepreneurs and their university spin-offs identified in this dissertation, I also found similarities. There are certain recurring patterns and problems in the interaction between the university, the academic entrepreneur and the university spin-off that are very specific for the phenomenon of academic entrepreneurship. For example, problems with the role identify change of long-time academics and the dependency of the university spin-off on the academic entrepreneur, the position within a university or the university itself

are oftentimes reflected in the growth of a university spin-off. Furthermore, I revealed growth paths that are very typical for university spin-offs, such as the one of late bloomers or entrepreneurial academics. In this way, the results of this dissertation legitimize the phenomenon of academic entrepreneurship as a separate field of research (DJOKOVIC/SOUITARIS 2008).

In the following paragraphs, the results and contributions in regard to the three major themes of this dissertation are discussed in more detail. These major themes are attitudes, careers and growth intentions and each is of central importance in at least one of the three core papers.

6.1.1 Major Results for Attitudes

The aim of Chapter 3 was to analyze the entrepreneurial potential of prospective scientists in comparison to prospective entrepreneurs. In this respect, attitudes that can be linked to an entrepreneurial mindset were of major interest. These are attitudes towards self-realization, recognition, independence, innovation, role models, financial success and social welfare. In the study, the relationship between students' intentions of becoming scientists or entrepreneurs and these attitudes were investigated. Quantitative data from the universities in Hannover and Göttingen were collected in the context of the Global University Entrepreneurial Spirit Students' Survey. The results of the multinomial and binary logistic regression surprisingly show that prospective scientists are indeed well equipped with attitudes which are conducive for starting a business. Both prospective scientists and prospective entrepreneurs find the realization of their dreams, independency and role models more important than other individuals. At the same time, they evaluate financial success less important than other individuals.

The study contributes to the present research on career attitudes of (nascent) entrepreneurs in general (e.g. CARTER et al. 2003; SCHEINBERG/MACMILLAN 1988; SHANE/KOLVEREID/WESTHEAD 1991) and on the self-employment intentions of students (e.g. BERGMANN/CESINGER/OSTERTAG 2012; HAASE/LAUTENSCHLÄGER 2011; TKACHEV/KOLVEREID 1999; ZELLWEGER/SIEGER/HALTER 2011). Also, the different views of literature on the reasons for the decision of scientists to leave the university for starting up a business (e.g. FINI/GRIMALDI/SOBRERO 2009; FRITSCH/KRABEL 2012; GÖTHNER et al. 2012; KRABEL/MUELLER 2009; LAM 2011; NÖRR 2010; STUART/DING 2006) and on the career attitudes of scientists (HAGSTROM 1975; MERTON 1973; SAUERMAN/ROACH 2012; STEPHAN/LEVIN 1992), are augmented by examining the career attitudes of students with entrepreneurial and scientific career intentions. As far as I know, a direct comparison of the

career attitudes that are helpful for starting up a business or embarking on a scientific career is still nonexistent in the literature. However, this is an important issue in view of the fact that universities have a new “third mission” and increasingly want their research staff to be involved in the commercialization of research results by university spin-off formation (ETZKOWITZ et al. 2000).

By examining the career attitudes of students with entrepreneurial and scientific career intentions, it is possible to investigate the original career attitudes of students. The general viewpoint is that scientists and entrepreneurs have different attitudes (MANGEMATIN 2000). Indeed, the results show a few differences between the two groups. Most importantly, prospective entrepreneurs have a greater desire for financial success and independence and a lower desire for recognition compared to prospective scientists. However, the present results also indicate that, concerning the majority of attitudes, prospective entrepreneurs and scientists do not differ all that much. This in turn indicates that entrepreneurs and scientists become increasingly different only after their career choice has been made because of the different socialization processes at a university or in a company (DING/CHOI 2011).

6.1.2 Major Results for Careers

Chapter 4 investigated how the career paths of academic entrepreneurs can influence university spin-off growth. I used qualitative survey data from 87 academic entrepreneurs which was collected in the context of the USO research project. The results show that academic entrepreneurs found businesses at very different stages in a career, whereby each career stage comprises certain advantages and disadvantages for university spin-off growth. On the one hand human capital increases during the time at a university, which is not necessarily an advantage because of the very specific knowledge transferred. This makes the university spin-off quite dependent on the academic entrepreneur, which is disadvantageous in the long run. On the other hand the university status normally increases during the time at a university. This is an advantage because the academic entrepreneur has then a higher reputation and probably easier access to resources and customers. However, the university spin-off will again be highly dependent on the specific person and his/her position at the university. Another important factor is role identity. Engaging in the entrepreneurial role becomes more difficult with advancing time at a university. This sometimes leads to initial difficulties like the orientation towards the market or profit-maximizing thinking. Especially this last factor has a great influence on university spinoff growth because academic entrepreneurs who cannot decide for one role, will follow the entrepreneurial career only part-

time which hinders university spin-off growth in most cases. Career paths definitely have an influence on the growth intentions of academic entrepreneurs and this in turn affects university spin-off growth.

The study contributes to a better understanding of the career paths of academic entrepreneurs and their effects on university spin-off performance by applying three different research perspectives: human capital (BECKER 1975; LAZEAR 2005), university status (PHILLIPS/ZUCKERMAN 2001) and role identity (JAIN/GEORGE/MALTARICH 2009; MERTON 1973). It is an ambitious task to examine career paths because they extend over a long period of time and include decisions which are path dependent and interrelated (DRUILHE/GARNSEY 2004; KODITHUWAKKU/ROSA 2002). While the connection between entrepreneurs' career paths and their growth intentions are still inconclusive (BIRLEY/WESTHEAD 1994; CASSAR 2007; KOLVEREID 1992), I was able to shed some light on this issue by connecting the career paths of academic entrepreneurs with their growth intentions and the resulting university spin-off growth. The qualitative research design has proven to be more useful compared to quantitative research designs that make it necessary to define rigid independent variables beforehand. The current study also contributes to the existing literature on university spin-off development and performance because, as far as I know, the time spent at a university and resulting growth intentions have not been considered to be important for the subsequent university spin-off performance.

6.1.3 Major Results for Growth Intentions

Due to the fact that many studies on the development and performance of university spin-offs neglect the circumstances that academic entrepreneurs do not necessarily strive for profit maximization and university spin-off growth (BAUMOL 1968), Chapter 5 qualitatively investigated why many university spin-offs remain small. By comparing academic entrepreneurs' intention to the growth of university spin-offs (DAVIDSSON 1989) I derived four basic types of university spin-offs: ambitious, unwilling, saturated and impeded. Based on a concept of growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007) I also identified eight different subtypes of university spin-offs: ambitious, standards, life stylists, entrepreneurial academics, hesitators, late bloomers, choked and survival artists. The study uses qualitative survey data from 68 academic entrepreneurs which was collected in the context of the USO research project.

The results demonstrate that the majority of university spin-offs remain small. It shows that academic entrepreneurs' growth intentions are crucial for university spin-off growth because

only if both conditions are met, growth willingness of the academic entrepreneur as well as growth ability of the university spin-off, the university spin-off will grow. About 40 % of the academic entrepreneurs do not pursue growth. The reasons for this lack of growth intentions lie in a preference for a personalized technological interest and creativity (“lifestyle university spin-offs”), university work (“entrepreneurial academics”) or a strong risk aversion (“hesitators”).

Almost one third of the university spin-offs in my sample are run by academic entrepreneurs with growth intentions but are inhibited from further growth. They either endure an extended startup phase (“late bloomers”), an interrupted growth path (“choked”) or no growth at all (“survival artists”). I can thus confirm the hypothesis of DOBBS and HAMILTON (2007) on small business growth as the conclusions show that university spin-offs are also heterogeneous regarding their growth paths, although they even originated from two universities located in the same federal state with comparable environments.

The types of university spin-offs can change over time and are partly dependent on the particular phase in the growth path. Certain internal and external events can cause a change. To give only two examples: A university spin-off with ambitious growth targets in the beginning, may reach an impasse by growing too quickly and beyond their capabilities due to the pressure of an external investor. Subsequently this academic entrepreneur may become more cautious towards a revival of growth. As a second example, lifestyle entrepreneurs may pursue more ambitious growth targets when they obtain personnel assistance in the management tasks. The results indicate that only if both requirements are met, growth ability and willingness, the university spin-off will grow.

Since the empirical evidence on university spin-off growth is quite ambiguous (ENSLEY/HMIELESKI 2005; HELM/MAURONER 2007; NIGHTINGALE/COAD 2011), the contribution of this study to the literature is a more profound knowledge on the growth process of university spin-offs by considering the growth willingness of the academic entrepreneur. According to the necessity for future research (DOBBS/HAMILTON 2007; NICOLAOU/BIRLEY 2003), this study adopted an evolutionary perspective and can reflect the diversity of university spin-off growth paths. Unlike exclusively economic studies, I understand growth not only as a consequence of an economic process but also as a personal and social process. In this way, this study also augments the existing concepts of growth phases (GARNSEY 1998; LEWIS/CHURCHILL 1983; PENROSE 2009; STAM 2007). Although, there might be studies on single types of entrepreneurs and businesses in general or

specifically on academic entrepreneurs and university spin-offs (ERDÖS/VARGA 2012; HELM/MAURONER 2011; NICOLAOU/BIRLEY 2003) but no studies have comprehensively generated university spin-off types. This study goes one step further by not only systematically investigating the revealed university spin-off types with their very specific growth paths but also by connecting them with each other.

6.2 Implications for Further Research

The results of this dissertation leave some open questions that should be addressed by future research. While a number of detailed implications for future research have been suggested in the above chapters, this chapter focuses the three most important general implications.

Firstly, career attitudes are dynamic in nature. Therefore, it would be interesting to analyze how career attitudes change and if original career preferences come true over time. Here, longitudinal data would offer further insights. A first step in this direction could be projects such as the German National Educational Panel Study (NEPS) (SCHAEFER 2013). Furthermore, it would be interesting to investigate how the entrepreneurial support structure at a university or the influence of professors shape the career attitudes of the students.

Secondly, the predominant black-and-white way of research on academic entrepreneurship - either a person is an academic entrepreneur or not - does not meet reality. A central point in this dissertation is that - as BURT (2000:2) has already stated - "*shades of gray*" exist between these two extremes. Further research should therefore address the topic of scientists being part-time entrepreneurs. This phenomenon has hardly been considered in literature so far, but it is worth investigating because a lot of them are out there and they may represent an untapped potential for the university and the region (JAIN/GEORGE/MALTARICH 2009; NICOLAOU/BIRLEY 2003). The cases in my sample show that these kind of academic entrepreneurs maintain a strong relationship with the parent university, as they are more dependent on knowledge transfer.

Thirdly, this dissertation revealed that growth intentions of academic entrepreneurs have a crucial influence on university spin-off growth. Further research on university spin-off development and performance should also consider academic entrepreneurial growth intentions to be an important factor. Furthermore, although this dissertation already examined how different career paths shape the academic entrepreneur's growth intentions, there are still open questions. For example, according to AJZEN (1991) it would be interesting to find out to what extent social norms, which considerably vary between regions, influence the growth

intentions of academic entrepreneurs. One just has to think on the cultural differences between the United States and Germany. While in the United States the career plan of “being a dishwasher to becoming a millionaire” is respected and recognized, in Germany such persons are rather deemed to be capitalists and regarded more skeptically (KRIMPHOVE 2011). These differences certainly have an influence on the academic entrepreneurs’ growth intentions.

6.3 Implications for Policies

Some policy recommendations can be derived from the results of this dissertation. However, it should be noted that there is no general recipe on how to promote university spin-off generation and growth. Any policy should consider the specific regional context and, as outlined above, my results may not apply to other universities. Nevertheless, I make some general recommendations for encouraging university spin-off creation and university spin-off growth that at least apply to the universities in Hannover and Göttingen.

6.3.1 Encouraging Entrepreneurial Activity at the University

Universities can encourage entrepreneurial activity by sensitizing their students and fostering the development of their entrepreneurial attitudes. Entrepreneurship educators as well as university instructors should include elements into their curricula, which stimulate the development of entrepreneurial attitudes, since these are also valuable for a career in academia or employment (DOUGLAS/SHEPHERD 2002). This is theoretically possible, because the itinerary of the Bologna Process encourages freely selectable curricula and the development of key competences (SCHAEFER 2008). In practice, these possibilities are still insufficiently used for developing entrepreneurial attitudes.

Entrepreneurial potential can also be enhanced by creating opportunities where students and researchers with differing career attitudes and skills come together (BREITENECKER/SCHWARZ/CLAUSSEN 2011). For example, while technically interested students and researchers may have the intention and ability to be innovative, other more business oriented students and researchers may have the intention and ability to exploit a business opportunity and manage a university spin-off. Also, the scientific expertise, reputation and far-reaching social networks of established researchers coupled with the risk disposition and flexibility of students or younger researchers could lead to fruitful collaborations. My results show some positive examples where professors are shareholders and scientific advisors, but the operating business is performed by graduates, so that both

sides benefit from each other. Bringing these people and ideas together could take place in interdisciplinary classes on entrepreneurship for example. Also, the active search for inventions and product ideas at the institutes by the technology transfer office is quite conceivable. On this basis, study projects could be carried out, in which business students develop a business plan for researchers' inventions.

6.3.2 Encouraging University Spin-off Growth

If the aim of supporting university spin-offs is the encouragement of growth, it should be kept in mind that academic entrepreneurs determine to a great extent the growth path of university spin-offs. The allocation of subsidies therefore should not only depend on a high degree of knowledge transfer or a high reputation of an academic entrepreneur. Instead, it is of particular importance to consider the university status and career plans of the academic entrepreneur in order to compensate particular disadvantages of different university statuses. For example, young academic entrepreneurs with a low university status may suffer from a lack of management skills, reputation or resources. Other examples are a high dependency of the university spin-off on the university, a lack of commitment to the university spin-off or problems with role identity change of older academic entrepreneurs with a higher university status.

Appropriate support should address both the academic entrepreneur's willingness to grow and the university spin-off's ability to grow. Furthermore, the respective phase in a university spin-off's life cycle has to be considered when encouraging university spin-off growth. Tracing the reasons behind missing abilities and intentions to grow is crucial because a modification of the certain limiting factors may have a considerable effect on university spin-off growth. In this way, it is also possible to typify university spin-offs and to offer them suitable support. For example, financial support or legal advice can be given to "late bloomers". "Life stylists" or "entrepreneurial academics" can liaise with managers.

At this point the issue may arise whether regional policy makers and universities should pursue the goal of supporting university spin-off growth at all. Small innovative university spin-offs have also positive effects on the region because they contribute to the regional economic diversity (COHEN/KLEPPER 1992). Given that only a very few university spin-offs show strong growth, scientists and policy makers should be aware of the alternative benefits for the region and for the university, apart from employment and profit. Especially in the German context, this is of particular importance because German universities usually do not

acquire shares in the university spin-offs and do not receive any financial benefits (HEMER/DORNBUSCH/KULICKE 2010).

According to the new “third mission” of universities (ETZKOWITZ et al. 2000), knowledge transfer is a central objective for encouraging university spin-offs (PHAN/SIEGEL 2006). The cases in my sample show that small university spin-offs tend to have a stronger relationship to the parent university. This is due to the higher dependency on the knowledge transfer and the fact that academic entrepreneurs often work part-time in his/her spin-off as well as at the university. These so-called “entrepreneurial academics” may also promote the acceptance of university spin-off creation among their colleagues and the university as a viable way of knowledge transfer from university to industry (NICOLAOU/BIRLEY 2003).

Finally, one should keep in mind that growth is a two-edged sword because it can cause problems if it occurs too quickly. Fast growth often happens under pressure by external investors, as some cases in my sample show. The question is therefore whether it is maybe more sustainable if a university spin-off grows in a safe and sound manner than quickly and ruthlessly in the long run (HEMER et al. 2006).

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Annex

Annex 1: Descriptive Statistics of Students' Career Attitudes and Control Variables

		Career choice intentions: five years after studies																
		Prospective Scientists				Prospective Entrepreneurs				Prospective Employees				Total				
		Median	Min	Max	N	Median	Min	Max	N	Median	Min	Max	N	Median	Min	Max	N	
Career Attitudes	Self-realization	Realize my own dream	6	1	7	423	6	1	7	829	6	1	7	1344	6	1	7	2596
	Financial Success	Earn a larger personal income	5	1	7	423	5	1	7	829	6	1	7	1344	5	1	7	2596
	Role models	Follow example of a person I admire	2	1	7	423	2	1	7	829	1	1	7	1344	2	1	7	2596
	Innovation	Be innovative, at the forefront of technology	4	1	7	423	4	1	7	829	4	1	7	1344	4	1	7	2596
	Recognition	Achieve something, get recognition	6	1	7	423	6	1	7	829	6	1	7	1344	6	1	7	2596
	Independence	Be my own boss	4	1	7	423	6	1	7	829	4	1	7	1344	4	1	7	2596
	Social Welfare	Follow a social mission	5	1	7	423	5	1	7	829	4	1	7	1344	4	1	7	2596
Control Variables	Dummy university	Göttingen				249				386				620				1255
		Hannover				174				443				724				1341
	Dummy PhD	No				350				763				1203				2316
		Yes				73				66				141				280
	Dummy Master	No				311				548				859				1718
		Yes				112				281				485				878
	Dummy gender	Male				207				473				755				1435
		Female				216				356				589				1161
	Dummy nationality	German				389				736				1284				2409
		Foreign				34				93				60				187
Dummy Family Business Background	No				284				458				926				1668	
	Yes				139				371				418				928	

Source: Own calculations based on GUESSS 2011.

Annex 2: Correlation Matrix Spearman Rho for Students' Career Attitudes and Control Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
		Dummy gender (female=1)	Dummy nationality (foreign=1)	Self-realization	Financial Success	Role models	Innovation	Recognition	Independence	Social welfare	Dummy family business background (yes=1)	Dummy university (Hannover=1)	Dummy PhD (PhD=1)	Dummy Master (Master=1)
1	rho	1.000	.007	.072**	.027	-.050**	-.249**	.041*	-.070**	.124**	-.037*	.134**	-.019	-.006
	p	.	.682	.000	.130	.005	.000	.022	.000	.000	.039	.000	.282	.720
	N	3138	3138	3121	3123	3119	3111	3117	3116	3120	3138	3138	3138	3138
2	rho		1.000	.059**	.083**	.088**	.100**	.055**	.101**	.055**	.027	-.104**	.004	.070**
	p		.	.001	.000	.000	.000	.002	.000	.002	.135	.000	.826	.000
	N		3138	3121	3123	3119	3111	3117	3116	3120	3138	3138	3138	3138
3	rho			1.000	.171**	.051**	.134**	.298**	.286**	.218**	.049**	.060**	-.052**	-.043*
	p			.	.000	.005	.000	.000	.000	.000	.006	.001	.004	.016
	N			3121	3116	3112	3104	3110	3109	3113	3121	3121	3121	3121
4	rho				1.000	.021	.128**	.381**	.185**	-.123**	.011	-.072**	-.044*	-.016
	p				.	.231	.000	.000	.000	.000	.533	.000	.013	.378
	N				3123	3116	3108	3113	3112	3115	3123	3123	3123	3123
5	rho					1.000	.184**	.152**	.138**	.138**	.073**	.021	-.014	-.003
	p					.	.000	.000	.000	.000	.000	.239	.450	.878
	N					3119	3108	3112	3110	3112	3119	3119	3119	3119
6	rho						1.000	.267**	.218**	-.012	.061**	-.102**	.008	.011
	p						.	.000	.000	.497	.001	.000	.647	.554
	N						3111	3105	3103	3105	3111	3111	3111	3111
7	rho							1.000	.193**	.084**	.016	-.016	-.006	-.016
	p							.	.000	.000	.382	.374	.730	.364
	N							3117	3107	3110	3117	3117	3117	3117
8	rho								1.000	.146**	.083**	-.003	-.021	-.008
	p								.	.000	.000	.857	.237	.647
	N								3116	3111	3116	3116	3116	3116
9	rho									1.000	.014	.057**	-.024	-.019
	p									.	.429	.001	.175	.279
	N									3120	3120	3120	3120	3120
10	rho										1.000	.009	-.008	-.014
	p										.	.612	.667	.435
	N										3138	3138	3138	3138
11	rho											1.000	.116**	-.062**
	p											.	.000	.001
	N											3138	3138	3138
12	rho												1.000	-.238**
	p												.	.000
	N												3138	3138
13	rho													1.000
	p													.
	N													3138

Source: Own calculations based on GUESSS 2011.

Annex 3: Interview Manual for Qualitative Survey

Main subjects	Sub-topics
1. Academic career and pre-start-up phase	<ul style="list-style-type: none"> • Studies and employment at university • Development of the entrepreneurial desire • Entrepreneurial motivation • Business idea and knowledge transfer
2. Course of the start-up phase	<ul style="list-style-type: none"> • Restraints and problems (identification with the entrepreneurial role and management skills) • Use and importance of national, regional or university funding and support • Role of supervisor, colleagues, institute and university • Role of family and friends • Identification of key persons
3. University spin-off development since foundation	<ul style="list-style-type: none"> • Development of the number of employees and structure of employees • Development of the market and turnover • Development of the current competitive situation • Development of the innovation activities
4. Cooperation and contacts with other companies or regional organizations	<ul style="list-style-type: none"> • Role of national, regional or university funding and support for business development • Cooperation with other companies and research institutions • Informal contacts
5. Knowledge and/or technology transferred from university and core competences of the business	<ul style="list-style-type: none"> • Types of knowledge transfer • Motives for knowledge transfer • Characteristics of the knowledge transferred
6. Engagement as alumni spin-off entrepreneur and transfer of start-up experiences	<ul style="list-style-type: none"> • Contribution to the evolution and/or realization of a university's entrepreneurial support structure by exchanging start-up experiences • Exchange of experiences with regional actors • Engagement in business or start-up networks • Informal exchange of experiences • Motives for exchanging respectively not exchanging start-up experiences
7. Milestones	<ul style="list-style-type: none"> • Important milestones in the spin-off's history that have been achieved from the beginning until today
8. Relevance of certain individual traits for entrepreneurship	<ul style="list-style-type: none"> • Opinion on the issue of entrepreneur's traits as important determinants for the realization and success of start-up
9. Future prospects	<ul style="list-style-type: none"> • Growth willingness • Growth ability • Concrete plans for expansion

Annex 4: Post-interview Questionnaire

- 1 Date and place of the interview
 - 2 Name of Founder
 - 3 Name of Company
 - 4 Year of official company foundation
 - 5 Place of foundation
 - 6 Status of the Founder
 - 7 Number and names of founding members
 - 8 Institute and faculty
 - 7 Year when founder left the university
 - 9 Business field
 - 10 Sector
 - 11 Year of founder's birth
 - 12 Current number of employees
 - 13 Qualification structure of employees
 - 14 Share of full- and part-time employees
 - 15 Moved from outside into the city for studies or employment at university?
 - 16 Contact information for further questions, information or copy of the interview
 - 17 Subsidiaries with place and number of employees
 - 18 Turnover classified 2010
(no turnover, less than 10.000, 10.000 to 20.000, 20.000 to 50.000, 50.000 to 100.000, 100.000 to 500.000, 500.000 to 1 Mio., 1 to 1,5 Mio., 1,5 to 2 Mio., more than 2 Mio.)
 - 19 Profit/revenue ratio 2010 (in %)
 - 20 Geographical distribution of turnover (in %)
(region, Lower Saxony, Germany, Europe, rest of the world)
 - 21 Purchase of preliminaries from suppliers or service providers
 - 22 Location of suppliers or service providers
(region, Lower Saxony, Germany, Europe, rest of the world)
 - 23 Use of materials as a share of turnover (in %)
-

Curriculum Vitae

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10/2010 – 10/2014	PhD student at the Institute of Economic and Cultural Geography, Leibniz Universität Hannover PhD thesis: Academic Entrepreneurs: Attitudes, Careers and Growth Intentions (grade: magna cum laude)
09/2008 – 02/2009	Exchange student at the Universidad Complutense de Madrid, Spain
02/2007 – 03/2007	Study visit at the Texas State University in San Marcos, USA
10/2004 – 02/2010	Diploma studies in Geography at the Leibniz Universität Hannover Study focus: Economic Geography Minors: Business Management/Marketing and Economics/Developmental Economics Diploma thesis: Highly skilled employees in Germany - spatial mobility and regional availability of jobs (grade: 1,3)
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