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Individual and Structural Influences on the Entrepreneurial Activities of Academics

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Abstract: In this paper we study how and to what extend (i) individual working conditions (e.g. peers, working atmosphere, work contract incentives, wage satisfaction), (ii) institutions (e.g. technology transfer offices, patent exploitation agencies, chair in entrepreneurship or awards for academic entrepreneurship) and (iii) network relationships simultaneously affect the likelihood of engaging in entrepreneurial activities (nascent entrepreneurship) in academia. Using unique data collected from 5.992 academic scientists in 73 German Universities Germany, we find that entrepreneurial peers and performance based monetary incentives have a strong positive effect on the entrepreneurial intentions. We show that, although there is a comprehensive support infrastructure for start-ups in German academic institutions, these services are little known amongst their staff. Finally we find that market related networks show a high correspondence with high entrepreneurial intentions, whereas networks within the own university do not have any impact. Several mentioned aspects were analyzed before, but mostly on a limited sample (e.g. only stem field), isolated personal variables (e.g. gender) or isolated environmental aspects (e.g. peer groups). Our study provides a holistic view on the impact of several university-specific structural factors on entrepreneurial intentions among academic scientists in Germany by simultaneously focusing on personal and occupational characteristics for different faculties.

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1 Introduction

Transferring knowledge out of the university into the private industry is one of the most important sources for generating innovation and economic growth (e.g. Arvanitis et al. 2008; Shane 2004;). Accordingly, governments all around the world encourage their universities to become more active in transferring their knowledge from academia into private industry. Certainly, starting a new firm is one of the most striking ways for transferring knowledge from academia into the market and consequently foster technology development on a macro level. Thus, recent shifts in university and government policies aim at establishing a stronger entrepreneurial spirit among the scientific staff of universities (Shane 2004).

However, up to date and to our best knowledge, empirical evidence taking into account individual as well as institution-specific structural and environmental factors that affect scientists' entrepreneurial intentions remains scarce. Surprisingly little is known, for example, about whether and how specific incentive schemes provided by universities efficiently raise the start-up inclination of the scientific staff, despite the perceived importance of knowledge transfer from universities. But in order to enhance the effectiveness of commercial exploitation of research-based innovation, it is important to understand the specific factors influencing the entrepreneurial intentions of academic scientists.

Our study fills this research gap by analyzing, how (a) individual working conditions, e.g. work place endowments, work contracts and income, peers, (b) institutions, e.g. technology transfer offices, patent exploitation agencies, chairs in entrepreneurship or start-up awards, and (c) networks affect the likelihood of the scientific staff to get engaged in entrepreneurial activities.

Using unique data collected from 5.992 academic scientists in 73 institutions of higher education in Germany from a wide range of faculties, we find that specific working conditions and institutional offers as well as most of our network relationship dimensions affect the propensity of academic scientists to start a new venture.

The paper is organized as follows: In the next section, we discuss some theoretical perspectives which may help explain the propensity of scientists to become entrepreneurs and derive the hypotheses. Section three explains the operationalization of our dependent and independent variables and provides the regression results. Finally, in section four, we discuss our results, indicate the limitations of our study and make some concluding remarks.

2 Theory and Hypotheses

Recent changes and developments in university and government policies aimed to foster an entrepreneurial climate in universities to facilitate the technology transfer to private industry and thus to foster technological development. The main goal of these enactments is to motivate scientists and universities to generate more research output that can be commercialized. However, literature shows that most scientists still seem to have low entrepreneurial intentions and many universities are still far away from being "entrepreneurial" (Cuntz et al. 2012). Moreover, the results of these studies indicate that the motivating factors for university scientists to transition into entrepreneurship may be very specific and just related directly to the transition process, but are situated in earlier stages of the entrepreneurial decision process. For this reason, the following chapters focus on workplace conditions, networks and institutional factors which might influence the personal propensity of academic staff for entrepreneurship.

2.1 Working Conditions

Entrepreneurial intentions are determined by several personal and environmental factors. Within the entrepreneurship research, environmental determinants, which foster entrepreneurial intentions and start-up propensity, are subdivided into pull-factors and push-factors. Pull-factors constitute positive causes and expected incentives of an entrepreneurial career, e.g. self-fulfillment, gaining a broader range of competencies or commercialization of one's human capital, whereas push-factors are reactions to insufficient conditions and lead to a desire to escape or avoid dissatisfactory working conditions, e.g. (impending) unemployment or a dissatisfying workplace culture (Sass 2011). While pull-factors are linked to opportunity entrepreneurship and are seen as factors that affect entrepreneurial intentions directly in a positive manner, push-factors are rather linked to necessity entrepreneurship and foster entrepreneurial intentions allusively, as one possible "way out" of a (potentially) precarious situation.

Within this distinction, the individual working conditions of academic staff at institutions of higher education can be subdivided into monetary incentives peer-effects that can stimulate or inhibit entrepreneurial propensity. In the study at hand we analyze, whether and how such specific working conditions affect the entrepreneurial propensity of academicians at German institutions of higher education.

2.1.1 Monetary Incentives

Monetary incentives are often used to regulate staff's behavior by defining objective agreements and providing performance-linked compensation, bonuses or other monetary incentives (Lazear 1992). Objective agreements require objective and observable criteria in order to provide a feedback directly linked to the employee's performance (Kräkel 1996). Especially individuals with a high need for achievement strive for a performance-based feedback and incentives directly linked to the output, therefore monetary incentives based on objective agreements are effective for this group. At the same time, the need for achievement is one of the personality traits most linked to entrepreneurial behavior and entrepreneurial propensity as well as generally to high performers in the workforce. There is empirical indication that entrepreneurs have a significantly higher degree of need for achievement than other respective groups (Stewart and Roth 2007).

Within the entrepreneurship research, performance-based monetary incentives are discussed and empirically proven as one of the key motives for entrepreneurial activity of academics. Depending on the arrangement, they can be seen as a pull-factor, for example to achieve higher earnings and to commercialize human capital, as well as a push-factor, e.g. as a reaction to the dissatisfaction with current compensation (see e.g. Corolleur et al. 2004; Isfan et al. 2005; Sass 2011).

Based on the theoretical and empirical review of the literature following hypotheses can be derived:

Hypothesis 1: Performance-based monetary incentives as bonuses to the agreed upon salary increase the entrepreneurial propensity.

Hypothesis 2: High satisfaction with the current compensation diminishes the entrepreneurial propensity of academics.

2.1.2 Peer Effects

Throughout the process of socialization, role models have a high impact on the development of motives and future career decisions. Several studies demonstrate that entrepreneurs' children show a higher entrepreneurial propensity than children of employees (Caliendo et al. 2011; Lang 2003). However, not only family members and peers within the socialization affect the entrepreneurial propensity, but also professional peers (Stuart and Ding 2006).

Peers can affect the entrepreneurial propensity either directly or indirectly, through institutional norms and culture, e.g. in school, university or the supervisor (Frank et al. 2003; Sass 2011). Therefore it can be assumed that the entrepreneurial culture at the institution on higher education or at the particular department can affect the entrepreneurial propensity. This also applies for entrepreneurial activities and attitudes of co-workers or supervisors. The effect is stronger the closer the individual is to the entrepreneurial role model. There is severe empirical evidence for these assumptions (e.g. Moog et al. 2012; Stuart and Ding 2006).

Several studies indicate that institutional attitude towards entrepreneurship affects the entrepreneurial activity of the academic staff. Kenney and Goe (2004) found out that an entrepreneurial culture within the faculty can foster entrepreneurial propensity of the staff, whereas Rasmussen et al. (2014) showed that a negative attitude towards entrepreneurial activities of scientists within the faculty inhibits entrepreneurial propensity of the employed academicians.

Individual role models affect the entrepreneurial propensity even more than institutional values. The better the reputation of the role model within the scientific community and the more visible the role model is, the bigger his/her impact on the entrepreneurial propensity of the academicians (Berggren 2011; Stuart and Ding 2006). Especially successful role models within the faculty that are involved in entrepreneurial activities are crucial for fostering entrepreneurial propensity among young academicians (Geißler et al. 2010; Isfan et al. 2005).

Based on the presented theoretical and empirical work, we derived following hypothesis:

Hypothesis 3: Professional peers engaged in entrepreneurial activities foster entrepreneurial intentions of academics.

2.2 Networks

The individual choice of an employee to pursue self-employment is not only attributed to the level of skills and to the conditions in the current workplace. Previous studies on this topic also support the assumption that external relations can have a strong impact on the creation of academic spin-offs (Elfring and Hulsink 2003; Grandi and Grimaldi 2003). However, up to date, it is still unclear how the quality of specific network relationships affects the scientist's willingness to found a new business. In the following, we address this question and get a deeper insight into the role of networks and their impact on entrepreneurial intentions among academic staff at institutions of higher education.

According to knowledge spillover theory, the context of decision-making has an impact on one's determination to found an own business (Acs et al. 2013). The theory is based on the assumption that profitable opportunities arise from knowledge spillovers. Innovation and new knowledge is regarded to be the key driving force for entrepreneurial investments. The processes of knowledge creation can thereby be stimulated by intensive forms of personal interchange (e.g. Ahmad and Ingle 2011). Cope et al. (2007) as well as De Carolis and Saparito (2006) argue that social capital, which is incorporated in networks, combined with personal factors foster entrepreneurial behavior. Social capital is regarded as a productive resource built in form of relations among agents, facilitating social and also economic transactions (Parker, 2004) as well as accumulating market specific knowledge. Based on common knowledge created over time, social capital leads to network externalities (Herrmann-Pillath 2000). The productivity of social capital stems from shared understandings, norms and expectations among network members (Ostrom 2000). Thus, social capital helps transferring information and other resources with comparatively small costs (Westlund and Bolton, 2003). Social interaction is of high economic value, if its use provides access to scarce and valuable knowledge.

Taking advantage of social capital by social interaction can furthermore help individuals to improve their entrepreneurial ability of decision making and increase their entrepreneurial intentions, calculated risk propensity and also to detect market opportunities (Acs et al. 2013). Therefore, networks can be perceived as a productive factor, since scientists employed at university rarely holds all the required resources. Thus, being embedded in a respective network can become a precondition for planning and preparing a start-up venture.

Leyden and Link (2013), for example, go into greater detail and discuss the specific role of networks for scientists employed at universities in the context of entrepreneurship. The authors point out, that collaborations with stakeholders from the private sector can facilitate the knowledge transfer. According to this assumptions, scientists, who have ties to potential clients and suppliers, can profit from the access to strategic resources and more attractive conditions. The knowledge gained from these network relations might strengthen the ability of these academic employees to start their own business. These considerations lead to our next hypotheses:

Hypothesis 4: Market related networks foster entrepreneurial intentions among academics.

Martinez and Aldrich (2011) furthermore assume that diverse networks somehow are positively related to higher entrepreneurial activity. Therefore, the knowledge transfer is reinforced by an increasing number of different network partners. This is also a reason why diverse network relations can have a positive impact on the research productivity of scientists. This latter effect might encourage those individuals embedded in networks to use them in order to commercialize their research output. This assumed seed function of a network will be explored by the following hypothesis:

Hypothesis 5: A high variety of networks has a positive impact on the entrepreneurial intentions of academics.

2.3 Institutions

Institutions of higher education can be described as incubators, i.e. as a support system for researchers willing to found a new business. This became a strategic goal of institutions of higher education and is realized by incentivizing academic entrepreneurship for students as well as for the academic staff. The respective university concepts aim for raising awareness among the academic staff and fostering

entrepreneurial spirit. Moreover, they can also improve the visibility and reputation of start-up enterprises for potential customers.

The typical entrepreneurial support services usually consist of chairs for entrepreneurship offering lectures and courses about entrepreneurship, consulting and support programs offered by technology transfer offices, or start-up and idea workshops, contests and awards. Moreover, as information on property rights becomes relevant, university offers provide information on these issues, as well.

The respective offers incentivizing academic entrepreneurship differ greatly in scope and diversity between German institutions of higher education. The following core activities, however, are predominantely found at universities and cover the different stages of the start-up founding process: (a) entrepreneurial education, (b) consulting and supporting offers, (c) start up workshops and contests (d) patent exploitation agencies.

2.3.1 Entrepreneurship Education

The Theory of Planned Behavior by Ajzen and Fishbein (1980) explains human behavior and the development of individual intents for action. Ajzen (1991) finds that actions will be performed particularly after persons develop intent to act. This intent arises from the attitude towards an action as well as from subjectively perceived social standards. If intent to act has developed, individuals will actually perform the action if they are able to control it and have knowledge of whether they will be able to go through with it. Shapero's model (1984) is based on similar assumptions, but directly targeted at entrepreneurial action. Shapero (1984) views the components of "desirability" and "feasibility" to be triggers for becoming a nascent entrepreneur. Accordingly, an enterprise will be founded if it appears desirable and feasible (Wagner, 2006: 40). Furthermore, increasing knowledge about entrepreneurship will also increase the willingness to actually switch into self-employment (Isfan et al. 2005; Wagner 2006: 40).

Previous empirical studies suggest that entrepreneurial education at universities mostly has a positive influence on the willingness of students to found enterprises (e.g. Isfan et al. 2005; Lüthje and Franke 2003; Mayhew et al. 2012; Peterman and Kennedy 2003; Schwarz et al. 2009; Souitaris et al. 2007; Turker and Selcuk. 2009; Walter et al. 2013). Thus, we develop the following hypothesis:

Hypothesis 6: Entrepreneurship education programs foster entrepreneurial intentions of academics by increasing the desirability and feasibility of entrepreneurship.

2.3.3 Consulting and Supporting Offers

Nearly all German institutions of higher education maintain technology transfer offices to stimulate technology transfer activities as a statutory premise. They facilitate the transfer process either directly by initiating co-operations between the university and businesses, or indirectly by raising awareness for entrepreneurship among their academic staff. However, the financial resources of technology transfer facilities vary strongly, which also affects their services. Technology transfer offices can consist of one single person or a large team with individual project managers and specialists as consultants, e.g. for legal matters. This influences their performance, as shown by Hülsbeck et al. (2013). According to the study by Kratzer et al. (2010), strong division of labor in the transfer organizations has a positive effect on the number of published university inventions.

In addition to direct consulting and support offers, founders' or idea awards are applied as a qualification strategy. They are at times organized by technology transfer offices or their network partners. Even though the respective details of such awards can vary a lot, they are usually targeted at improving the business plan and facilitating the pre-seed phase by evaluating and offering specialized advice related to marketing, sales and industry-specific aspects, management, accounting or financial and investment plans (Waldmann et al. 2010). Since the awards are often organized regionally, networking with regional partners is facilitated and regional media coverage increases visibility of the future businesses (Zu Knyphausen-Aufseß and Goodwin 2009; Waldmann et al. 2010). Thus, we generate the following hypothesis:

Hypothesis 7: Technology transfer offices foster the entrepreneurial intentions of scientists by reducing information costs.

2.3.4 Start-up Camps

Transferring new research results into market-ready products or services is a special challenge in the process of founding an enterprise (acatech 2012). Particularly basic research common in universities is

often unpredictable regarding its relevance for the industry. Founders' workshops can therefore be helpful by giving potential founders the chance to test their product ideas with prototypes or a product for the market.

Founders' start-up camps at institutions of higher education provide a start-up infrastructure for the pre-seed phase, such as equipped office rooms, special devices and lab facilities. The latter often require high investments that founders cannot provide by themselves. Particularly capital-intensive start-ups can therefore be greatly supported by start-up camps, while new enterprises with low capital intensity will consider these rather less important. The access to this infrastructure will reduce the capital bottleneck (Stahlecker and Lo 2004). Thus, we state the following hypothesis:

Hypothesis 8: Start-up camps foster entrepreneurial intentions of academics by reducing investment costs.

2.3.5 Patent Exploitation Agency

The role of universities in the patent utilization process in Germany has changed substantially with amendment of "§ 42 ArbnErfG", a statute originally providing university professors with unrestricted right to use and commercialize inventions they made as part of their research duties. With the mentioned amendment, the property rights of university research results swapped from the individuals to the institutions. From there on, the legally protected (e.g. as patents) and commercially exploited research outputs belong to the institution and the inventor receives 30 % of the gross income. In exchange, the institution will bear all costs for applying for the patent and commercialization.

At least one patent exploitation agency per Federal state was founded for this purpose. The patent exploitation agencies evaluate the inventions and decide whether they should be patented. The agencies also offer, among other things, consulting services for founding projects establish and administrate contacts and co-operations with market partners, negotiate and supervise contracts as well as offer courses and training events for inventors (Hoeren 2005). Therefore we hypothesize:

Hypothesis 9: Patent exploitation agencies foster the entrepreneurial intentions of scientists by reducing investment costs.

3 Data and Variables

To shed more light on whether and how individual and structural factors affect the scientists' intention to start a new venture, we collected data on German university scientists. In November and December 2013 we sent a questionnaire to 36,918 scientists in 73 random sampled universities in Germany. The sample includes academicians from a variety of disciplines, amongst them: Mathematics, Information Sciences, Sciences and Technology, Social Science, Economics, Humanities and Health Care as well as Art and Design. We included all hierarchical levels of academic staff and academic degrees: research associates (PhD students and postdocs), assistant professors, associate professors and professors in tenure positions.

The standardized online survey consists of a bulk of questions about the employment history of the academicians in general, their current occupational situation and occupational aspirations in the near future, with a focus on their perception of entrepreneurial activities and entrepreneurial intentions as well as their individual networks. Furthermore, we ask them about the institutional infrastructure facilitating entrepreneurship and the entrepreneurial culture within their institution of higher education. In total 10,199 scientists responded to the survey and 5,998 completed the questionnaire, so they build our sample base for the further data analysis.

3.1 Dependent Variable

Entrepreneurial activity. Our dependent variable has three parameter values. At first, the academicians were asked, whether they have a basic business idea, regardless if its level of elaboration. This is an indication of entrepreneurial intentions. .If the answer was "no", we operationalize it as "no entrepreneurial intentions". If they affirmed, we considered this to be a basic or low-level form of entrepreneurial intentions. Finally, following the understanding by Reynolds et al. (2000), nascent entrepreneurs are Individuals who start investing time and resources into business foundation. Therefore, we

consider academics as nascent entrepreneurs if they created a business idea and have undertaken at least one of the typical activities for further elaboration of the business idea, e.g. having developed a business plan, made the idea known to potential customers or business partners, or talked to financiers. We consider these activities gestation activities.

The distribution of the entrepreneurial activity variable shows, that about one third of all the academicians within our sample have a business idea. Within the group of 2,033 (33.9 %) scientists with a business idea, 1,060 (17.7 %) scientists show no gestation activities. However, 973 (16.2 %) scientists have a business idea and have started to initiate at least one gestation activity. Following Reynolds et al. (2000), we consider these 973 scientists to be nascent entrepreneurs.

3.2 Independent Variables

Working conditions. Our sample includes information on a variety of specific working conditions for the academic staff at German institutions of higher education. Following the theoretical explanations in the last chapter, these experiences should be either conducive to switching into entrepreneurship or keeping the paid employment position in university. In particular, we collected data on (1) Performance-based monetary incentives in five different quality dimensions (i.e. hearing of appeals; research, lecturing, art; funding; human resources development in the faculty; administration); (2) satisfaction with current compensation in one dimension (i.e. Likert scale ranging from “1” very unsatisfied to “5” very satisfied) and (3) peer effects measured in three dimensions (i.e. entrepreneurial activity among colleagues and co-workers exists; conversation among colleagues about entrepreneurial activity of other colleagues within the faculty; conversation among colleagues about entrepreneurial activity of other employees and/or students within the institution).

Networks. With regard to the network ties, we included in our regression model contacts (1) to financiers; (2) to potential clients; (3) to potential other business partners; (4) to (trade) associations; (5) in a private sphere; (6) to scientists at the workplace (university); (7) to scientists at the other research entities and (8) a network variable capturing the variety of the different network partners.

Institutions — With regard to institutional influences, we included the following offers: (1) start-up camp; (2) founders' or idea award; (3) consulting; (4) coaching; (5) entrepreneurship education; (6) technology transfer office; (7) patent exploitation agency; (8) and a variable capturing the number of different offers used.

3.3 Control Variables

Finally, we included the following control variables in our regression models: (1) gender (1=scientist is female); age (in years); nationality (1=foreign); parent(s) employment (1=parent(s) are self-employed); partner's employment(1=partner is self-employed); type of university (1=university of applied sciences); subject field (1= Math/Engineering/Natural Science/Technology); position (1=professor); working hours (1=full time); side job/business (1=yes); type of research (basic, applied and multidisciplinary research) and invention (1=scientist has made an invention).

3.4 Analytical Approach

In the empirical models discussed below, we regress scientists' propensity to leave paid employment for self-employment on different working conditions, network relationships, institutional factors and the control variables discussed above. Overall, twelve different specifications of the empirical model are estimated. First, we calculated a basic model with the set of control variables discussed above. Based on this model, we then included the variables representing a broad range of working conditions (table 1-2). Third, we replace the working condition variables with our network relationship variables (table 3). Finally, we replace the network variables with the institutional variables (table 4). As our dependent variable is a three-item ordinal scale variable, the appropriate econometric model is a regression model for ordinal outcome variables. In the cases, where we comment on our results, we refer to the predictive probability that the scientist has a business idea and has already initiated at least one gestation activity (Likert scale value=3) compared to the situation where the scientist has no business idea (Likert scale value=1). Moreover, the empirical models presented here have robust standard errors with correction for heteroscedasticity.

4 Results

Regarding the effects of the individual *working conditions* on the entrepreneurial activity of academic scientists, three hypotheses were tested using multivariate regression analysis.

>Table 1 -2 around here<

The multivariate data analysis shows that, at a first glance, there is no statistically significant impact of of perform-based monetary incentives within the working contract (c.f. table 1). On the second glance, the the analysis shows, that the quality of the agreed incentivized performance can have either positive or negative effect on the entrepreneurial activity of academicians, so the effects level each other out: Monetary incentives based on performances in research, lecturing or art foster the entrepreneurial activity by 4,5 percentage points, whereas incentives based on administrative tasks inhibit the entrepreneurial activity by 5,4 percentage points. Both single effects are statistically significant and show opposing effects on the entrepreneurial activity.

Table 2 (model 3) shows, that the satisfaction with current salary has a statistically significant negative effect on the entrepreneurial activity. The more satisfied with the current compensation at the institution of higher education, the less entrepreneurial activity can be observed. Therefore, the satisfaction with the current salary can also be considered a push factor. Table 2 (model 4) shows furthermore statistically significant positive peer effects on the entrepreneurial propensity of the responding scientists. Accordant to other reported empirical studies, role models have in general positive impact on the entrepreneurial activity of academics. The closer the scientist to the role model, the stronger the fostering effect on entrepreneurial activity: Visible and approachable role models, like colleagues within the faculty, have a stronger positive impact on the entrepreneurial activity than distant role models, which also still a positive, but weaker impact on the entrepreneurial activity.

With respect to the *network effects* on the entrepreneurial activity of academicians, two hypotheses were tested using multivariate regression analysis.

>Table 3 around here<

Referring to the Hypothesis 4, the probability of starting an own business increases by 21 percentage points, in case a scientist is able to make use of contacts to potential customers in beforehand (see table 3, model 5). Furthermore, the likelihood of a scientist commercializing her/his know-how into entrepreneurship is 13 percentage points higher, when contacts to potential other market partners e.g. suppliers) are maintained. Additionally, contacts with financiers like banks, public and private investors improve the probability of starting an own business by 7 percentage points. These findings support Audretsch and Acs (1990) notion, that the gathering of market-oriented expertise enables entrepreneurs to discover market chances and to start an own business. No statistically significant impact is detected in

the case of contacts to (trade) associations. The positive network effects are not restricted to external business relations: Further analyses lead to the conclusion that nascent entrepreneurs depend even more on private contacts (see table 3, model 6). This result underlines the importance of the support that founders receive from family members and friends. In addition, the findings indicate that contacts to other scientists outside the own research institute are of great importance as well.

Model 7 in table 3 provides an insight into the effects of network size on the propensity of scientists to start an own business (see also Hypothesis 5). The entrepreneurial activity increases on average by 6 percentage points when network relations are gradually expanded. However, with the amount of different contacts, the effect is levelling off. The findings confirm the research results of Semrau and Werner (2014), who noted that the relation between the size of a nascent entrepreneur´s network and the access to start-up relevant resources is showing a positive, but concave correlation. The findings are also in line with the results of Reynolds (1997), who concluded that spin-offs mostly occur in networks of smaller size.

With respect to the impact of the *institutional factors* on the entrepreneurial activity of academic scientists, four hypotheses were tested using multivariate regression analysis (see Hypotheses 6-9).

>Table 4 around here<

In contradiction to some other studies, we found no evidence that the attendance of an entrepreneurship lecture enhances the likelihood to develop an entrepreneurial spirit (Hypothesis 6). However, our results indicate that consulting offers, start-up camps, awards and patent exploitation agencies go along with a higher entrepreneurial activity (Hypotheses 8 and 9). In contrast, this effect does not hold for technology transfer offices, which do not offer any individual services for potential business founders (Hypothesis 7, Table 4, Model 9). This finding is consistent with the results of the studies made by Hülsbeck et al. (2013) and Kratzer et al. (2010), who found out, that a strong division of labour in the transfer organizations increases the service efficiency and enhances the entrepreneurial spirit at the university. In other words, a broader number of different services by different specialists foster the entrepreneurial activity among academic members of the institutions of higher education. This is consistent with our results which show a statistically significant positive impact of the variety of used services on the entrepreneurial activity of academics (Table 4, Model 10).

5 Discussion and Outlook

In this paper, we applied economic reasoning and multivariate modeling to analyze, which specific factors influence the entrepreneurial activities of academic scientists. We used ordered logit models to analyze different aspects of institutional impact (working conditions, networks and infrastructure) on the entrepreneurial activity of academicians with respect to personal and vocational circumstances for the academic staff as well as their attitudes and aspirations towards entrepreneurship.

With regard to the *working conditions*, we find that performance based monetary incentives and peers show clear pull effects regarding the entrepreneurial propensity of scientists in German academic institutions. Monetary incentives can have a conflictive impact on the entrepreneurial propensity in dependence of their particular quality. Offering incentives for research, lecturing and art is beneficial for entrepreneurial activity, whereas incentivized administrative activities have an inhibitory effect on it. Professional peers have also a strong positive effect on the entrepreneurial personality. Especially close and visible role models engaged in entrepreneurial activities foster the propensity to also become an entrepreneur within the academic staff. Furthermore, the satisfaction with the current salary has an inhibitory effect on the propensity to become an entrepreneur, which is considered a push factor.

With regard to the *network effects*, the regression results largely confirm our hypotheses. Network relations turn out to be a key feature in explaining the entrepreneurial activity and intention to generate academic spin-offs in Germany. Potential startups are clearly influenced in the first place by private relations, but also by market-related business contacts. Founders strongly rely on these relations. There is some evidence suggesting that, from a certain size of the network on, the positive effect on the entrepreneurial activity diminishes. Therefore, the results indicate that too broad networks are not used effectively for putting the knowledge spillover to use.

The extent to which institutions of higher education provide specific *institutional support* in the pre-founding process reflects in the degree of entrepreneurial activity of the academic staff. To assure a broad and professional set of entrepreneurship facilitating infrastructure, smaller institutions of higher education should collaborate, e.g. by building clusters for entrepreneurial support, and extend their networks to supportive institutions, like chambers of industry and commerce in the region. The fact that entrepreneurship chairs do not show a significant effect on the entrepreneurial activity does not mean that such lectures have no impact in reality. At the one hand, the goal of an entrepreneurship education especially for groups with hardly or any knowledge about entrepreneurship is awareness training and qualifying the attendants to make an elaborate decision about this occupational choice rather than blindly pushing them into self-employment. An attendant who - based on the entrepreneurship education program - recognizes through the training, that being an entrepreneur does not suit his personal characteristics and needs, can be seen as a successful result of entrepreneurship education (Bijedić 2013). At the other hand, the effects of and entrepreneurship education as basic awareness trainings cannot be measured immediately and show their impact often delayed (Bijedić 2013). Finally, there are some restrictions to our results: we included a rather small range of entrepreneurship education programs into our analyses, like entrepreneurship lectures. Especially these offers are required courses for university members which have studied economics and therefore provoke a bias in the data. Furthermore, due to the cross level design of the study, the causality of the results remains ambiguous. Since longitudinal perspective is needed to distinctively prove the causal effects of the analysed determinants, we plan to conduct a second wave of the study.

To sum up the main results: Our analysis shows that individual and structural working conditions as well as network relationships influence the entrepreneurial activity of academicians. Moreover and to the best of our knowledge, this study is the first to use representative data to directly test how the academicians propensity to entrepreneurship are related to specific individual and institutional working conditions at once.

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Tables included in the text

Table 1: Ordered Logit Estimation Results: Monetary Incentives

Monetary incentives				
	Model 1		Model 2	
Variables	Probability of nascent entrepreneurship dF/dx	z-value	Probability of nascent entrepreneurship dF/dx	z-value
Performance-based monetary incentives ... …within the working contract (yes)	-0,004	0,24		
Quality of the agreed performance... …hearing of appeals (yes)			-0,030	1,30
…research, lecturing, art (yes)			0,045*	1,68
…funding (yes)			0,005	0,20
…human resources development in the faculty (yes)			0,020	0,59
…administration (yes)			-0,054**	2,45
Number of cases	5.992		5.992	
-2 Log-Likelihood	4613,87		4608,97	
McFadden R^2	0,120		0,121	

Significance level: *(0,1); **(0,05); ***(0,01).
Note: Regressions in all models include the set of control variables described in section 3.3

Table 2: Ordered Logit Estimation Results: Compensation and Peer Effects

Satisfaction with current compensation in relation to the category „very unsatisfied“				
	Model 3		Model 4	
Variables	Probability of nascent entrepreneurship dF/dx	dF/dx	Probability of nascent entrepreneurship dF/dx	dF/dx
Unsatisfied	-0,021	0,99		
Medium	-0,049**	2,45		
Satisfied	-0,075***	3,73		
Very satisfied	-0,088***	3,78		
Entrepreneurial activity among colleagues and co-workers exists (yes)			0,030***	3,57
Conversation among colleagues about entrepreneurial activity of other colleagues within the faculty (yes)			0,088***	5,00
Conversation among colleagues about entrepreneurial activity of other employees and/or students within the institution (yes)			0,029*	1,94
Number of cases	5.992		5.992	
-2 Log-Likelihood	4594,97		4574,48	
McFadden R^2	0,124		0,128	

Significance level: *(0,1); **(0,05); ***(0,01).
Note: Regressions in all models include the set of control variables described in section 3.3

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Table 3: Ordered Logit Estimation Results: Network Relationships

	Model 5		Model 6		Model 7	
Variables	Probability of nascent entrepreneurship dF/dx	z-value	Probability of nascent entrepreneurship dF/dx	z-value	Probability of nascent entrepreneurship dF/dx	z-value
Contacts...						
to potential clients (yes)	0,207***	3,47				
to potential other business partners (yes)	0,132***	9,07				
to financiers (yes)	0,077***	3,47				
to (trade) associations (yes)	0,001	0,10				
Contacts...[2)]						
in a private sphere (yes)			0,166***	15,79		
to scientists at the workplace (university) (yes)			0,004	0,35		
to scientists at the other research entities (yes)			0,046***	3,71		
Variety of network partners					0,059***	26,02
Number of cases	5.992		5.992		5.992	
-2 Log-Likelihood	4580,39		4715,90		4591,64	
McFadden R^2	0,127		0,101		0,125	

Significance level: *(0,1); **(0,05); ***(0,01).
Note: Regressions in all models include the set of control variables described in section 3.3

Table 4: Ordered Logit Estimation Results: Institutional Factors

	Model 8		Model 9		Model 10	
Offers	Probability of nascent entrepreneurship dF/dx	z-value	Probability of nascent entrepreneurship dF/dx	z-value	Probability of nascent entrepreneurship dF/dx.	z-value
... used (yes)	0,110***	8,06				
... Start-up Camp (yes)			0,093***	3,40		
... Founders' or Idea Award (yes)			0,058*	1,93		
... Consulting (yes)			0,101***	2,92		
... Coaching (yes)			0,038	0,99		
Entrepreneurship Education (yes)			0,020	1,02		
... Technology Transfer Office (yes)			-0,012	0,61		
... Patent Exploitation Agency (yes)			0,038*	1,66		
Number of different offers					0,042***	9,37
Number of cases	5.992		5.992		5.992	
-2 Log-Likelihood	4569,54		4544,01		4557,61	
McFadden R^2	0,129		0,133		0,131	

Significance level: *(0,1); **(0,05); ***(0,01).
Note: Regressions in all models include the set of control variables described in section 3