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Keywords: Jack-of-all-Trades, Skills, Entrepreneurial Intentions, Academic Entrepreneurship, Peer Effects, Working Time Balance

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Abstract: To date, little is known about the effects of the composition of skills on academic entrepreneurship. Therefore, in this paper, following Lazear's (2005) jack-of-all-trades approach, we study how his or her composition of skills affects a scientist's intention of becoming an entrepreneur. Extending Lazear, we examine how the effect of balanced entrepreneurial skills is moderated by a balanced working time allocations and peer effects. Using unique data collected from 480 life sciences researchers, we provide the first evidence that scientists with more balanced skills are more likely to have higher entrepreneurial intentions, particularly when they are in contact with entrepreneurial peers. Furthermore, we find even higher entrepreneurial intentions when balanced skill sets are combined with balanced working time allocations. Thus, to encourage the entrepreneurial intentions of life scientists, one has to ensure that they are exposed to diverse work experiences, have balanced working time allocations across different activities and work with entrepreneurial peers; i.e., collaborating with colleagues or academic scientists who have started new ventures in the past is important.

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1 Introduction

An increasing number of academic scientists have founded university spin-offs in the last decade by making use of their acquired knowledge as well as patents and licenses from universities (e.g., Etzkowitz 1989; Shane and Khurana 2003; Stuart and Ding 2006). However, compared to the general population, fewer academic scientists consider starting their own businesses; i.e., they tend to concentrate their occupational choices on being employees (Thurik 2003). Empirical evidence that relates the background of scientists and specific environmental factors to entrepreneurial activities remains scarce (Nicolaou and Birley 2003).

Our paper tries to fill this research gap by studying how a life scientist's skill composition affects his or her intention of becoming an entrepreneur. Specifically, we follow Lazears' (2005) jack-of-all-trades approach and examine the effects of balanced entrepreneurial skills on the propensity of scientists to become entrepreneurs. The fact that scientists – compared to non-scientists – are characterized by relatively homogeneous human capital at the beginning of their careers underlines the influence that balanced skill sets – acquired through more diverse work experience when working in academia in different academic settings – have on their occupational choices. In line with Lazear's key idea, we argue that, all else being equal, researchers who have a more balanced portfolio of skills are also more willing to transition into entrepreneurship in the near future. In particular, we study the experiences of researchers in different academic work activities and analyze the extent to which these (combined) activities affect their entrepreneurial intentions in the near future. In addition, we analyze how peers and balanced working time moderate the effect of a balanced portfolio of skills.

Using unique data collected from 480 life sciences researchers, we find that having a more balanced skill set positively affects the intention of becoming an entrepreneur in cases where organizational peers support entrepreneurial ideas and working time is more balanced. Thus, our results indicate a balanced skill set effect that is moderated by peer group and balanced working time. The present study contributes to the entrepreneurship literature by being the first to discuss the role of a balanced portfolio of skills among life scientists.

Recent work in the entrepreneurship literature has begun to shed some light on the effects of skills on the propensity of scientists to become entrepreneurs; however, most studies in this field of research focus on specialized experiences and thus neglect multifaceted experiences (e.g., Allen et al. 2007; Ding 2011; Ding and Choi 2011; Roach and Sauerman 2012). For example, Allen et al. (2007) present the first results that human capital indicators are directly linked to the extent of science-industry relations and patenting rates by scientists. However, this study does not focus on entrepreneurial activities. The studies that are most similar to our analysis are Stuetzer et al. (2012) and Moog and Backes-Gellner (2012). Stuetzer et al. (2012) find evidence that individuals with more balanced human capital portfolios have stronger entrepreneurial intentions. Moog and Backes-Gellner (2012) show that students with a more balanced skill sets have stronger intentions of becoming entrepreneurs and that this effect is stronger for male students than for female students. However, neither of the studies focuses on scientists nor analyzes how peer groups may moderate the effect of having a balanced portfolio of skills and balanced working time. Thus, our contribution is to apply Lazears' jack-of-all-trades theory to the special case of the entrepreneurial intentions of scientists in order to demonstrate that the effect of a balanced skill set is moderated by peer group and working time effects.

The paper is organized as follows. In the next section, we discuss how the jack-off-all-trades perspective can help explain the propensity of scientists to become entrepreneurs. 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 policies and governance structures have fostered an entrepreneurial climate in the university environment. Nevertheless, many scientists currently have no entrepreneurial intentions, and not all universities have become "entrepreneurial universities" as Etzkowitz (1983; 2001) described this new form of university habitus. For example, of 255,800 startups in Germany, only 6,800 (approx. 2.4 percent) are university spin-offs, and only 2,600 of these actually use knowledge created in universities and federal research institutions (Egeln et al. 2002). In addition, most university spin-offs are derived from engineering and the natural sciences (Isfan and Moog 2003). Consequently, there are several studies that address the question of why some scientists decide to start new ventures while others completely avoid moving towards self-employment (e.g., Landry et al. 2006; McMullen et al. 2008; Lam 2010). In sum, the results of these studies indicate that the factors motivating or driving university scientists to transition into entrepreneurship may be very specific.

2.1 Antecedents of academic entrepreneurship

One of the main factors related to entrepreneurial success is human capital (Audretsch 2000; Allen et al. 2007). Moreover, innovative start-ups, such as life sciences spin-offs, require their entrepreneurs to have broad skill sets in order for their ideas to be transformed into profitable ventures (Bygrave and Hofer 1991). Prior knowledge is seen as a key factor in enabling a spin-off to exploit new market opportunities (Shane 2000; Ardichvili et al. 2003; Venkataraman 1997), and a certain level of knowledge is a prerequisite for successfully recognizing and processing new external information (Cohen and Levinthal 1990; Qian and Acs 2011). Consequently, such treatment-based studies are often based on the notion that successful new firms depend on the founder's skills, knowledge and background and that these competencies are mostly related to what the founder has learned and observed during his or her previous jobs (e.g., Cooper 1985; Boeker and Fleming 2010). Following this line of reasoning, past work experience and gained skills are considered to be a key determinant of the knowledge of founders and their abilities to manage the specific challenges related to self-employment (Arentz et al. 2012).

Hills et al. (1999) support this view by using previous research to demonstrate that 50-90% of start-up ideas are derived from previous work experience. Consequently, new entrepreneurs can be seen as organizational products formed by the specific work environments that they were exposed to in their parent firms (Cooper and Dunkelberg 1986; Freemann 1986; Jones-Evans 1996; Shane 2000; Helfat and Lieberman 2002). Moreover, transferring such knowledge from the university into a spin-off can be described as a basic concept of imitation, adaptation, and transfer that has to be learned as a skill (Baumol 1993). Consequently, Dobrev and Barnett (2005:434) emphasize that it is important for employees (in our case scientists) to have access to 'varied and multifunctional role sets' in their parent firms; similarly, Elfenbein et al. (2010: 5) classify such entrepreneurial skills as relating to a 'broad exposure to various functions and ... tasks'. Following this general idea, Kakati (2003) identified a broad range of skills that a diversified management team or a single entrepreneur should possess; i.e., both managerial and technical skills. Along the same lines, Oakey (2003) argues that recognizing a complex mix of both managerial and technical skills is necessary for the success and the subsequent growth of innovative firms. However, what exactly are the entrepreneurial skills that researchers can develop in their parent organizations? Following Thurik (2002: 277), such skills can generally be regarded as a 'heterogeneous resource, consisting of a set of complementary human capacities'.

Within this research stream, Lazear (2005) has developed a model where such multi-skilled entrepreneurs – the so-called 'jacks-of-all-trades' – are more successful because they have multifaceted experience that enables them to overcome the numerous challenges associated with entrepreneurship (see also Erikson 2002; Wagner, 2003; 2004; Baumol 2005; Hyytinen and Maliranta 2006; Silva 2007; Moog and Backes-Gellner 2009). Moreover, many studies show that employees should be exposed to working conditions that provide a specific type of job variety or diversity to develop a broad knowledge base about how businesses are run and organized and to become learn how to act with great flexibility (Baron and Markman 2003). To approach this problem, Lazear (2005) developed the jack-of-all-trades approach, which differentiates among different types of skills. The jack-of-all-trades approach ascertains that an optimal mixture of human capital is essential for the founding of a start-up because an entrepreneur needs not only specific knowledge and human capital but also a generally balanced set of skills. This balanced set of skills is required because of the numerous challenges faced by entrepreneurs, such as the acquisition of capital or human resources management. In our paper, we assume that scientists acquire a variety of specific skills that are conducive to entrepreneurship by being exposed to specific working conditions.

Whereas there are several empirical findings relating to start-ups in general (for an overview, see Unger et al. 2011; Rauch and Rijsdijk 2011; Davidsson and Honig 2003; Park 2005) that support the idea that human capital increases the willingness to transition into entrepreneurship as well as the success of start-ups, few studies investigate the relation of human capital and university spin-offs, and even fewer examine the jack-of-all-trades approach in this context. Some of these studies find evidence that a balanced skill set supports entrepreneurial intentions as well as the success of new start-ups. Wagner (2004), for example, found evidence that the probability of being self-employed depends on the amount of different types of professional training and changes in profession. Baumol (2005) demonstrates that the human capital of independent inventors who found their own business differs from that of inventors hired by large firms. Whereas large firms are looking for highly specialized human capital, independent inventors require more balanced generalist human capital. Contrary to these findings, Silva (2007) found no evidence for the jack-of-all-trades approach. Finally, the study of Stuetzer et al. (2012) indicates that there is a positive relationship between a balanced set of skills and the progress of a nascent entrepreneurial venture in all types of entrepreneurship. Moog and Backes-Gellner (2012) find evidence that students with broader and more balanced sets of skills have stronger intentions of starting a business than other students.

Concurrently, research on the skills, experience or professional education (human capital: PhD, tenure, research productivity, publishing and patenting activities) of academic entrepreneurs is mostly conducted from an ex-post perspective (e.g., Ding 2011; Ding and Choi 2011; Roach and Sauerman 2012). Moreover, these studies generally do not integrate multifaceted experiences. For example, in an analysis of 400 scientists from US universities, Allen et al. (2007) find that specific human capital indicators, such as tenure, academic status, PhD experience, and discipline indicators, among others, are directly linked to the extent of science-industry relations and patenting rates by scientists. The authors argue that (faculty) patenting behavior can serve as an indicator of entrepreneurial activities. Comparing the effect of the prior activities of researchers on becoming a consultant or entrepreneur, Ding and Choi (2011) show that publication output, patent experience, co-authorships and networking are positively related to both the activities of consulting (scientific consulting for companies) and becoming an entrepreneur (founding an own company).

In summary, all of the previously mentioned studies follow the general idea that a scientist's endowment of human capital and specific skills is important for his or her occupational decisions, but none of these studies seem to directly focus on the jack-off-all-trades approach and the propensity of academic scientists to become entrepreneurs. In our study, we believe that scientists should also profit from balancing their skills with regard to their occupational choices if specific environmental and motivational aspects are taken into account.

2.2 Hypothesis

The fact that scientists – compared to non-scientists – are characterized by relatively homogeneous human capital at the beginning of their careers underlines the influence that balanced skill sets – acquired through more diverse work experience – have on their occupational choices. However, we argue that specific environmental and motivational aspects will also affect a scientists' propensity to become an entrepreneur instead of focusing on a university career. In other words, we believe that these specific environmental and motivational factors are the main reasons that scientists with balanced portfolios of skills have higher propensities towards entrepreneurship. Moreover, we believe that scientists also have to invest a reasonable amount of working time in the activities necessary for acquiring these skills. In line with this reasoning, we believe that more balanced working time should also help to build a more balanced set of skills that should affect the propensity of scientists under specific organizational circumstances to become entrepreneurs.

For instance, personal relationships and peer-group orientation are vital for shaping individual behaviors and ambitions (Stuart and Ding 2006a; Lam 2007; 2010). Young or new scholars are especially likely to orientate themselves according to existing norms or leadership behaviors. These norms, often provided by leaders in the academic context (i.e. the chair of the department or faculty), create the organizational culture (Bandura 1986; Bercovitz and Feldman 2008). Leaders influence the culture of an organization by communicating which attitudes are acceptable and which values should be internalized and shared (Shamir et al. 1993). The more prominent the leader's position, the more effective his or her influence on organizational norms is because individuals orient themselves according to prominent figures to a higher extent (Stuart and Ding 2006). If the chair of the department is highly involved in entrepreneurial activities, he or she sends a strong positive signal to the other scientists in the department regarding these activities, whereas a chair who avoids entrepreneurial activities negatively influences their entrepreneurial development (Bercovitz and Feldman 2008). However, organizational norms cannot solely be implemented by leaders because members of an organization could just symbolically abide by these norms (Alvesson and Willmott 1992). In fact, the organizational culture can only truly implement behavioral norms if the majority of faculty members comply with them. According to Stuart and Ding (2006), personal relations and networks are one of the most important factors of individual behavior and internalized norms. Peers can support entrepreneurial ideas and create pressure on individuals to internalize norms to conform to the peer-group. Individuals learn social norms through interactions with others (Bandura 1986). The closeness and especially the frequency of interactions strengthen the induced learning effects (Wright and Mischel 1987; Dohse and Walter 2011). Individuals compare themselves and their behaviors to those of other individuals who are similar to them. Thus, peers need to have similar social statuses, personal skills and interests (Ellison and Fudenberg 1993). For scientists, colleagues are the relevant peer-group relating to professional norms (Pelz and Andrews 1976). Thus, the level of collegial and organizational support is seen as one of the most important factors related to the entrepreneurial activities of scientists (Jain et al. 2009; Link and Ruhm 2011). In addition to the general culture, the personal influence of faculty environments on entrepreneurial activities should not be neglected. Thus, group leaders, department chairs or PhD or post-doc colleagues who were entrepreneurs in the past or who are involved in university-industry co-operation can provide other faculty members with contacts in the economic sector who could subsequently be used, for example, to acquire capital (Etzkowitz 1998; Shane and Stuart 2002). Scientists can also acquire entrepreneurial knowledge from experienced faculty members via spill-over effects (Acs et al. 2009). In addition, the prestige of a specific faculty and its members plays a major role the founding of academic spin-offs. Podolny and Stuart (1995), for example, find a positive correlation between the reputation of an organization and its likelihood of diffusing an invention.

Moreover, as previously mentioned, the environment for academic scholars has changed in the past two decades, and long-established Mertonian norms have given way to a more entrepreneurial approach (e.g., Powell and Owen-Smith 1998; Slaughter and Leslie 1997; Thursby and Thursby 2002; Nelson 2011). Individuals often perceive this changing environment as creating pressure on them to change their individual attitudes; i.e., to comply with the newly established norms (Dacin et al. 2002). Consequently, the implementation of these new organizational norms should additionally foster the previously discussed peer effects and, consequently, the propensity of scientists to become entrepreneurs (Louis et al. 1989; Thursby and Thursby 2002; 2004).

Thus, we hypothesize the following:

Hypothesis 1: If organizational peers support entrepreneurial ideas, then a more balanced set of skills and working time will positively affect the propensity to become an entrepreneur.

3 Data and Variables

To shed more light on whether the balanced skills of academic scientists affect their intentions of starting a new venture, we collected data on Swiss and German scientists in 2007. To collect the data, we developed an online questionnaire that was then emailed to 7,464 life scientists in universities in Switzerland and Germany. A total of 1,760 scientists responded to the survey, and 480 answered all the questions relevant to our empirical analysis, yielding a completion rate of 23.58 percent. Acknowledging that our sample is one of convenience, we compared it to data from the German Federal Statistical Office and the Swiss Statistical Office as well as Life Sciences Federal organizations in both countries. We find a high degree of similarity between the scientists within our sample and the scientists within the other data sources and are therefore confident that our sample is not seriously biased.

3.1 Dependent Variable

Propensity to become self-employed — For the composition of our dependent variable, we rely on the answers to question regarding the possible future career choices of the responding scientists. That is, the interviewees were asked whether they planned on becoming entrepreneurs in the near future and were also asked to estimate the probability of such an occupational change in the near future on a Likert scale ranging from 1 (very unlikely) to 5 (very likely). The distribution of this variable shows that nearly two-thirds (64 percent) consider this to be very unlikely and approximately 3.5 percent consider it to be very likely. We realize that intention-based measures represent only the first step towards becoming an entrepreneur and acknowledge that not all of the researchers who have intentions of becoming entrepreneurs will actually do so (Bessau et al. 2001; Blanchflower 2004; Reynolds 2007). However, many empirical studies have shown that actual entrepreneurs are a sub-sample of so-called latent entrepreneurs (i.e., people who have wished to become entrepreneurs in the past). Moreover, early entrepreneurial intentions have been shown to be the single best predictors of starting a business later on (i.e., Krueger et al. 2000; Villanueva et al. 2005) and represent the best measure of capturing the idea of preparing for an occupational choice. The 3.5 percent of our respondents who say that becoming self-employed is “very likely” are quite similar to the proportions of so-called nascent entrepreneurs (i.e., people who are actively involved in starting a new business by themselves or with others) found in the literature.

3.2 Independent Variables

Balanced set of skills — Our sample includes information on a variety of specific skills that have been acquired by the scientists through exposure to specific working conditions. Following Lazear’s jack-of-all-trades theory, the sum of these productive experiences should be conducive to entrepreneurship. In particular, we collected data on (1) patent activities; (2) licensing activities; (3) collaborative research activities with academic and non-academic third parties; (4) consultancy; (5) publications; (6) contract research; (7) free sharing of research results; (8) shared usage of equipment; (9) education of students and PhD candidates; (10) advising for master and PhD theses; (11) staff outflow; (12) contribution to committees, boards, and commissions, and (13) informal meetings and contacts. Following Lazear’s number of roles measure, we have constructed an additive index of up to 13 different researcher experiences to construct a balanced skill set drawn from these activities. In accordance with Schmoch (2003), we condensed the information on the different activities (how long, how much, etc.) by creating a set of binary variables (i.e., one indicator per activity). The higher the index value, the more balanced the skills of the responding scientist. Descriptive statistics reveal that the average scientist in our study is engaged in approximately 8.1 activities with a standard deviation of 2.

Working Time Balance — As an indicator of balanced working time, we use the distribution of the individual scientist's working time (as a percentage) with respect to the sum of his or her fields of activities and responsibilities. The seven possible categories underlying this variable include (1) teaching; (2) academic administration; (3) research; (4) non-commercial utilization of research findings; (5) commercial utilization of research findings; (6) procurement of new research projects; (7) other fields of activity. If a scientist's working time is perfectly balanced, he or she should spend exactly 1/7 of his or her total working time on each of these activities (i.e., 14.29 percent). However, not surprisingly, the observed values deviate from this perfectly balanced value. Thus, we constructed a balance score for each scientist based on the sum of his or her individual deviations from the perfectly balanced value. High negative values of this variable indicate a more unbalanced distribution of working time with respect to the previously mentioned fields of activity. Low negative values, in contrast, indicate a rather well-balanced distribution of working time. Descriptive statistics show that, on average, scientists are characterized by a deviation of approximately 38.5 percentage points from the perfectly balanced value, with a standard deviation of 11.2 percentage points.

Peer Effects — With regard to the entrepreneurial peer groups, we include a binary variable in our regression models for whether colleagues in the department have already started a new venture. A majority of 55.2 percent of the scientists in our sample stated that at least one person among their group leaders, department chairs or PhD or post-doc colleagues had been entrepreneurs in the past.

3.3 Control Variables

To control for department-specific effects and financial capital endowments, the regressions include a (standardized) faculty size variable that reflects the number of employees and budgets of the responding scientists' departments. Moreover, past research has also shown that socio-demographic factors can affect the propensity to become self-employed (Parker 2004). In Switzerland and Germany, as in many other countries, fewer women than men start new businesses. Ding and Choi (2011), for example, show that female scientists are about one fifth less likely than male scientist to become academic entrepreneurs (see also Murray and Graham 2007). In addition, older employees are considered to be more risk-averse than younger ones and are less likely to work the long hours that are often required of entrepreneurs. Jain et al. (2009), for example, found evidence for the idea that younger scientists are more likely to become entrepreneurs. We also control for the type of research a scientist is involved with. In the life sciences, it is common to differentiate between basic, applied and applied-orientated research (Henderson and Cockburn 1994; Ding 2005). Basic research, for example, is often seen as non-commercializable because of its mainly basic and theoretical nature. Finally, we also include one variable that denotes whether the university has a formal technology transfer office (TTO) and control for country effects by using a country dummy variable (1=Switzerland, 0=Germany).

3.4 Analytical Approach

In the empirical models discussed below, we regress the propensity of scientists to leave paid employment for self-employment on balanced skills, balanced working time, peer effects and the control variables discussed above. In addition to the balanced skill variable (additive index), we have also included the set of binary skill variables (i.e., one indicator for each activity) to control for specific activity effects. Overall, three different specifications of the empirical model are estimated. First, we test the role played by the set of binary skill variables and control variables discussed above, ceteris paribus (Model 1). Second, we include the variables representing balanced skills, balanced working time and peer effects (Model 2). Third, to test Hypothesis 1, we include a three-way interaction consisting of our three central variables: balanced set of skills, balanced working time and peer effects (Model 3). Because our dependent variable is a five-item ordinal scale variable, the appropriate econometric model is a regression model for ordinal outcome variables. When we illustrate our results, we display the predictive probabilities that the likelihood of becoming an entrepreneur is "very likely" (Likert scale value = 5). Moreover, the empirical models presented here have robust standard errors with correction for heteroskedasticity. We also checked the variance inflation factors (VIF) to exclude multicollinearity.

4 Results

Table 1 shows the estimation results. As displayed in Model 3, the three-way interaction effect of *Peers*Skill Balance*Working Time Balance* is statistically significantly different from zero at any conventional level (β=.010; $p<.05$). The predictive probabilities are displayed in Figure 1. The results show that scientists with highly balanced skill scores and high degrees of working time balance have a higher propensity to become entrepreneurs if they work with entrepreneurial peer groups in their departments. Thus, Hypothesis 1 is supported by the data.

> Table 1 about here <

> Figure 1 about here <

Regarding our control variables, in line with prior research, we find that gender has a strong effect on the intention of starting a business. Female scientists are much less willing to spin-off or start a business compared to their male counterparts, all else being equal. Moreover, with regard to age, we find evidence for the idea that younger scientists have a higher propensity to become entrepreneurs in the near future relative to their older counterparts. Additionally, the research focus of the department demonstrates the expected effects. If the department falls into the category of basic rather than applied research, then the scientists in that department have a lower propensity to become entrepreneurs.

4 Discussion and Outlook

Despite the importance of academic entrepreneurship, empirical evidence that relates scientists' backgrounds to their intentions of becoming entrepreneurs remains scant (Nicolaou and Birley 2003). Our paper has contributed to filling this research gap by studying how a scientist's human capital composition (Lazear 2005) affects his or her intentions of becoming an entrepreneur in the near future. By analyzing the standard working conditions that scientists are exposed to at their workplaces, we find that those who are engaged in more diverse activities are also significantly more likely to have higher start-up intentions when working in an entrepreneurial environment. In other words, those scientists who are engaged in many different fields in the context of their academic work simultaneously develop a higher propensity to transition into entrepreneurship in the near future compared to those researchers who undertake a lower number of activities due to their enhanced skill sets. Thus, our results are in line with those of Ding and Choi (2011), who show that publication flow, patent experience, co-authorships and networking have a positive influence on scientists becoming entrepreneurs. The same holds for the study of Stuetzer et al. (2012), who find that individuals in non-academic settings with a more balanced portfolio of human capital have higher entrepreneurial intentions, and for the study of Moog and Backes-Gellner (2012), who observe these effects in students across all disciplines. The interesting point here is that, for scientists, the effect of a balanced skill set holds only when it occurs in a peer environment that is positively related to entrepreneurship. This peer-related result is supported by the findings of other studies (e.g., Etzkowitz 1998; Shane and Stuart 2002; Stuart and Ding 2006; Bercovitz and Feldman 2008; Acs et al. 2009). Our results add one more contribution to the discussion of academic entrepreneurship in terms of considering the three-way-interaction: this provides significant support for our hypothesis, which proposes that the positive moderating effect of entrepreneurial peers and balanced skills are significantly stronger when scientists balance their working time across different activities. Technically speaking, this implies that these scientists are perfectly established in the new scientific mode described by Etzkowitz (i.e., 2003): they "live" the entrepreneurial university.

Following Lazear (2005), we have argued that typical academic activities as described in Schmoch (2003) require a different knowledge base and resources (Ding and Choi, 2011). Working in an industry collaboration with other researchers, for example, requires a team and project management (Gieryn 1983; Louis et al. 1989; Franzoni and Lissoni 2009), whereas patenting requires 1) the general idea, 2) the knowledge of how to protect the idea and 3) how to sell the patent (Henderson et al. 1998; Agrawal and Henderson 2002; Lam 2007; Fabrizio and DiMinin 2008). Assuming that the relationships between these activities are important, we believe it is necessary to undertake an integrated analysis of the effect of multiple activities regarding the continuum of transfer and commercialization activities. Thus, a complementary approach seems reasonable in revealing the potential relationship between multiple transfer activities and their synergy effects with the willingness to become an academic entrepreneur. Therefore, we choose the index approach and combine 13 different academic activities as a proxy for the most balanced individual academic human capital. This operationalization delivers insightful results. However, future research could analyze each working condition in more detail, such as by examining the length, extent, scope or range of the experience or how specific activity sets interact and differ in quality.

In our paper, we aim to demonstrate that individuals engaging in the generation of the previously mentioned skill combinations develop stronger intentions of becoming self-employed by viewing this type of occupational choice as chance to gain higher incomes or utilities in later stages of their careers – either outside academia or in combination with an academic career. In contrast to Lazear (2005), Åstebro and Thompson (2011) claim that the relation of varied work histories to entrepreneurship 'an also be explained by the simple story that individuals with a taste for variety prefer to become entrepreneurs because doing so provides utility.' Ghiselli (1974) defined this as 'hobo syndrome.' Both theoretical approaches positively relate work or experience variety to entrepreneurship. In our paper, we do not discuss or analyze this aspect due to data restrictions. Thus, further research could explore these two approaches and attempt to discriminate between them in the academic field by relating variety to income data. Moreover, the discussion in the first section provides the first hints that this hobo approach could also be supported here because scientists could choose to place themselves in environments where they could pursue their preferences for variety. However, this again could only be tested using different data, especially longitudinal data.

With regard to the controls dealing with university support, we surprisingly find no significant effects on entrepreneurial intentions. In other words, our data does not enable us to support previous findings that TTOs and entrepreneurship courses for scientists have a positive impact on the entrepreneurial intentions of researchers. Thus, even though most of the literature supports the idea that the presence of a TTO supports the entrepreneurial activities of scientists (i.e., Lowe and Gonzales-Brambila 2007; Nosella and Grimaldi 2009), this effect seems to depend on the quality of the TTO (size, age, specialization of the TTO employees, incentives, etc.). For example, it could be the case that the TTOs in our sample were mainly created to transfer knowledge into the commercial arena through patenting and licensing and that supporting spin-offs may have not been their main purpose. Moreover, the insignificant effect of our TTO variable could be attributed to the fact that TTOs in Germany are organized quite differently than those in Switzerland. In Germany, often only one employee – coming from the administrative staff – is associated with the TTO, whereas the TTOs in Switzerland are much bigger and employ individuals from outside the university who have industry experience and specific industry backgrounds. Moreover, Swiss TTO members frequently try to foster a trusting relationship with the scientists working in their university. Thus, in future research, the age, number of employees and type of TTO work culture and strategy should be analyzed in more detail; i.e., for example, by comparing Switzerland and Germany to deliver more thorough results (Isfan and Moog 2003).

Regarding the age effect in our results, we believe that it is caused by the specific characteristics of the life sciences, in which spin-offs often require long periods of time before generating real profits, such as after several rounds of venture capital funding. Thus, the cash-in-effect will occur much later than in non-academic start-ups. Thus, following the general idea of human capital investment behavior, older individuals will not invest in this type of “risky” occupational choice because this type of investment will deliver no short-term rewards (i.e., the amortization of the investment will be postponed due to industry-specific conditions (Van Geenhuizen and Soetanto 2009)).

The effect of our gender variable is consistent with prior research (Ding et al. 2007; Murray and Graham, 2007). Women are much less likely to start academic spin-offs in the same way that their general propensity to transfer into self-employment is lower than for men. We find stronger differences in the context of scientific entrepreneurship, where even fewer women plan on becoming or actually become founders of spin-offs. This might be due to the working conditions in the life sciences, where it is difficult to balance family concerns and careers due to long working hours and time spent in the lab (nightshifts, etc.) (Ding et al. 2009).

In conclusion, we believe that our work on the entrepreneurial intentions of scientists provides a useful starting point for more comprehensive studies on the occupational choices of researchers. Despite some limitations, we believe that our study provides novel insights into the career decisions of scientists. We provide the first evidence that researchers with broader experience in terms of diverse academic working conditions develop stronger intentions of becoming academic entrepreneurs when working in a peer-supported entrepreneurial environment. This finding, in turn, highlights the importance of recognizing that researcher experiences in different academic tasks (teaching, research and transfer) represent the most important factors in determining entrepreneurial intentions. Thus, the idea in life science faculties - and more and more in other faculties - of increasingly focusing on publications in journals for career decisions could be detrimental to the entrepreneurial initiatives of scientists; in contrast it would be helpful to also foster or honor collaboration with industry or patenting in appeals procedures when young scientists are applying for a research group leading position or a professorship. However, our analysis is only a first step. Future research should provide more in-depth analyses of the human capital skills and experiences of scientists, the quality and quantity of different skill combinations related to different peer or institutional environments and the resulting synergy effects. This future research should help to more explicitly examine how the experience and skill profiles of scientists relate to their entrepreneurial intentions, their founding of start-ups and the eventual success of their entrepreneurial activities.

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Tables included in the text

Table 1: Ordered Probit Estimation Results

DV: Entrepreneurial Intentions (5-item-Likert scale)	Model 1 Coef.	Model 2 Coef.	Model 3 Coef.
Controls			
Faculty Size	-0.003 [0.037]	-0.004 [0.038]	-0.001 [0.038]
Gender (1=female)	-0.327** [0.139]	-0.321** [0.140]	-0.281** [0.142]
Age (in years)	-0.022*** [0.007]	-0.021*** [0.007]	-0.022*** [0.008]
Country (1 = Switzerland)	0.044 [0.160]	0.025 [0.162]	0.003 [0.163]
Basic Research[1]	-0.294** [0.136]	-0.307** [0.138]	-0.284** [0.138]
Applied-oriented Research[1]	0.163 [0.122]	0.169 [0.123]	0.178 [0.124]
TTO	-0.008 [0.119]	0.002 [0.119]	0.002 [0.119]
Skill Dummy Variables			
Patent Activity	0.257** [0.124]	0.064 [0.182]	0.076 [0.184]
Licensing Activities	0.150 [0.122]	-0.034 [0.187]	-0.024 [0.187]
Collaborative Research Activities	0.027 [0.143]	-0.157 [0.209]	-0.140 [0.210]
Consultancy	0.540*** [0.136]	0.377** [0.189]	0.350* [0.188]
Publications	-0.753** [0.380]	-0.932** [0.397]	-0.930** [0.413]
Contract Research	0.236 [0.149]	0.078 [0.194]	0.096 [0.195]
Free Sharing of Research Results	0.333 [0.280]	0.111 [0.334]	0.137 [0.347]
Shared Usage of Equipment	-0.006 [0.196]	-0.171 [0.254]	-0.168 [0.255]
Education of Students and PhDs	-0.397 [0.289]	-0.583 [0.348]	-0.522 [0.349]
Coaching of Master and PhD Thesis	0.094 [0.356]	-0.082 [0.403]	-0.007 [0.428]
Contribution to Committees etc.	0.090 [0.144]	-0.064 [0.192]	-0.032 [0.194]
Informal Meetings and Contacts	0.090 [0.126]	-0.101 [0.119]	-0.100 [0.195]
Central Variables			
Skill Balance		0.166 [0.131]	0.011 [0.197]
Work Time Balance		-0.001 [0.006]	0.027 [0.031]
Skill Balance*Work Time Balance			-0.004 [0.004]
Peers		0.136 [0.119]	-2.599 [1.745]
Peers*Skill Balance			0.358* [0.199]
Peers*Work Time Balance			-0.072* [0.040]
Peers*Skill Balance*Work Time Balance			0.010** [0.005]
Log likelihood	-487.4	-485.9	-483.6
Observations	480	480	480

[1]Reference: Applied Research.. Robust standard errors in brackets. ***, **, * indicate significance at 1%, 5%, and 10% level, respectively.

Figures included in the text

Figure 1:

Three-Way Interaction: Skill Balance, Time Balance and Peer Effects