Determinants of Success in University Careers: Findings from the German Academic Labor Market

Erfolgsfaktoren in der Wissenschaft – Ergebnisse aus einer Habilitiertenbefragung an deutschen Universitäten

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Summary: What factors determine the chances of being appointed to a chair in Germany? We propose to derive hypotheses from discrimination theory, social and human capital theory, and the signaling approach. In a survey we sampled scholars from mathematics, law and sociology who had completed their Habilitation ("second book") from 1985 and 2005 at West German universities. A young age at the time of completion of the Habilitation is beneficial across all disciplines. In sociology, the number of publications included in the Science Citation Index is the most important factor in attaining a chair, and women are at an advantage when they face the same conditions as do men. In the field of law, parents’ years of education have a significant impact on success, as has having a highly respected mentor. In mathematics, the chances of getting a professorship increase significantly with high occupational prestige of the parents, the share of time spent in research, the specialty of applied mathematics, or having a mentor with a high reputation.

Keywords: Social Inequality; Labor Market; Academic careers; Universities; Disciplines; Habilitation; Social Capital; Productivity.

1 Introduction

In this paper, we analyze the determinants of success in academic careers in three disciplines: mathematics, law and sociology. How important are non-meritocratic aspects such as gender, social origin and social and institutional capital compared to performance and achievement? Can we find universal criteria for performance-measurement in each discipline, or, do disciplinary cultures imply different measures of evaluation for scientific achievements?

The research hypotheses derived from the theoretical considerations will be analyzed by comparing cohorts of young researchers who successfully com-
pleted their habilitation\(^1\) in three selected disciplines at universities in West Germany from 1985 to 2005. We decided to choose the disciplines mathematics, law and sociology in order to have a large scope of different academic cultures so that we can generalize the mechanisms investigated: Mathematics represents disciplines with a very high level of standardization in productivity measurement, as in many other natural sciences. Sociology is a subject chosen by people with a relatively low parental socioeconomic status which is the opposite from those who studied law, who often have parents who are lawyers themselves. Moreover, law is an interesting subject as the level of standardization in measuring academic performance is very high until the stage of the second state examination and very low thereafter (see Gross et al. 2008).\(^2\)

We believe our study is groundbreaking as no other comparable study has ever been conducted. No other study covers the German academic labor market, making use of habilitation cohorts from a number of disciplines and providing detailed information on the determinants of academic career progression alongside with measures of productivity. Since we not only included people still in academia, but all those awarded a habilitation over twenty years, our data does not suffer from the survivor bias at this stage as do many other studies (e.g., Hillmert 2003; Heining et al. 2007; however, see Schulze et al. 2008 for an exception). The advantage of investigating a specific cohort at a late stage in their scientific career-path is twofold: (1) only those pursuing an academic career are included since the habilitation is of limited value in the non-academic labor market. (2) Since non-successful persons are included, tests of determinants are possible. In an additional inquiry, we were able to confirm that our sample is not biased. These pros are balanced by the con that habilitations have become less important in Germany. Recent data show that in 2011 the number of habilitations in Germany was one third less than the peak level in 2002 (Statistisches Bundesamt 2012). Therefore, future studies investigating academic careers have to select from Ph.D. cohorts even though not all these people plan to become professors. An online survey was conducted in spring 2008 to collect information on occupational careers, productivity, social and institutional capital. To explain the outcome – the chance of being appointed to an associate or full professorship (or a comparable position) – we use event history techniques.

2 Determinants of Success

2.1 Achievement and Success in Academic Labor Markets

According to Merton (1973) scientific acknowledgement should be based on achievements. Therefore, highly productive scientists should be most successful in academic labor markets. In a similar way, human capital theory (Becker 1993[1964]) assumes that productivity influences income and success in the labor market in general; highly productive employees are most attractive for employers. Although all those in our study have a similar human capital in terms of certificates, they differ in their productivity. Since early productivity in scientific careers is a good approximation of later productivity, we argue that:

\[ H1: \text{Higher productivity enhances the chances of being appointed to a chair.} \]

There is consensus in academia that the necessary achievements include a number of publications besides the habilitation thesis. However – depending on the cultural habits in the discipline – monographs, papers in peer-reviewed journals or in other journals, and papers in anthologies are evaluated differently. What kinds of publications are required and which are preferred depends on methods of communication, traditions and the habits of the discipline. Disciplines belonging to arts and human-
cities still prefer monographs and do not discriminate greatly between papers in journals or anthologies. The quality of a publication is usually assessed by close reading. On the other hand, disciplines in natural science or economic sciences prefer publications in peer-reviewed journals that are evaluated by bibliometric measures. Publication culture in law is still oriented towards the criteria of arts and humanities, whereas in mathematics, publications in peer-reviewed journals count most. Sociology lies in between these two cultures. Since the indicators of achievement differ between the disciplines in our empirical analysis, we decided to analyze the disciplines separately to model these effects in interaction. However, achieving the habilitation at a young age is, on the whole, an advantage in making career progress in all of the examined disciplines.

2.2 Ascriptive Characteristics and Discrimination

Ascriptive characteristics such as gender, social origin and ethnicity are particularistic criteria that should have no bearing on scientific careers. Direct discrimination exists if different levels of success cannot be explained by achievements and productivity. Additionally, social mechanisms that lead to fewer publications or research grants may reflect indirect discrimination. In 2008, the year in which the data collection was conducted, the share of women among all professors in social sciences was 29 percent, followed by law with 14 percent and mathematics with only 11 percent (Statistisches Bundesamt 2009: 102f.).

Women are a growing group within the different stages of academic careers. However, men more often hold tenure positions and continue to be more likely to be tenured. The largest difference between the share of women among students and the proportion of female professors a decade later can be found in female-dominated disciplines (Lind & Löther 2007). One explanation is the degree of formalization and standardization within the discipline. Within more formalized and standardized structures, achievement can be evaluated independently from individual characteristics such as gender. In fields of study with high proportions of female students, young men strive for success early in their careers (Heintz 2004). Some studies have investigated gender earning differentials in the academic labor markets (Barbezat 1988; Monk & Robinson 2000). Women earn less despite numerous controls for experience, seniority, rank, tenure status, institution type and research productivity (Barbezat 1988; Monk & Robinson 2000).

The main reason for lower achievement by women in the academic labor market may be their productivity and publication behavior. On average, women publish fewer papers than men (Reskin 1978; Xie & Shauman 1998; Long 1992; Mauleón & Bordons 2006; Schubert & Engelage 2011). Xie & Shauman (1998) found out that different personal characteristics as well as structural variables – like academic rank, research funding or research assistance – and facilitating resources account for women’s lower productivity. Having enough resources is in most fields of research an important precondition for publications. Some results show that women do not receive as many research grants as men (Wenneräs & Wold 1997, 2000; Allmendinger & Hinz 2002) or spent more time than men on student mentoring (Probert 2005). Additionally, recent papers support the idea that gender differences in productivity could be explained by a lower degree of specialization by women (Leahey 2006, 2007, 2008).

A bibliometric study among Spanish scientists in the area of material science, however, has shown that female research scientists publish in higher-impact journals than men in the same rank but do not publish as many papers (Mauleón & Bordons 2006). Papers written by women are cited more often (Long 1992). In Scandinavia, Aaltojärvi et al. (2008) analyze the influence of individual and institutional characteristics on citation frequency and web visibility (number of clicks on papers at Google Scholar). In contrast to Long’s (1992) findings, articles by men are cited more often whereas web visibility is influenced more by institutional characteristics (Aaltojärvi et al. 2008). Summarizing these results, it can be concluded that quantity seems to be more important than quality in academic careers if measured by publications in high-impact journals or citations (Long et al. 1993).

Other reasons for disadvantages of women in academia are additional qualifications such as the leading study groups or undertaking temporary employment abroad especially in technical and natural sciences. Women adopt these functions less often or later in their careers (Hess et al. 2011).

Besides those differences between scientific careers of women and men that can be explained by different styles of productivity, theoretical explanations for instances of direct discrimination still exist. The preference for people with similar characteristics is called homophily (Hansell 1984; Ibarra 1992; Beggs & Hurlbert 1997; McPherson et al. 2001; Mouv 2003, 2006). Because of the general ten-
dency towards homophily and the finding that men and those from higher social classes are overrepresented among members of deciding committees, it could be argued that these groups may have higher chances of success. Besides that, Becker (1971 [1957]) supposes that people are even willing to pay a price (i.e. accept lower productivity) for cooperating with similar people, which he calls taste-based discrimination. The approach of statistical discrimination (Phelps 1972a, 1972b) presupposes that even without a taste for discrimination disadvantages for a smaller group in a population may arise. Employers do not have enough information to estimate the productivity of minority members effectively. From this theoretical reasoning the following hypothesis is derived:

H2: The chances of women becoming associate or full professors are poorer than the chances of men.

Does social origin influence the chance of becoming a professor? Hartmann (2002) investigated the careers of Ph.D. candidates of different cohorts since 1955 in three disciplines (engineering, law, economics) in Germany. He showed that social origin plays a crucial role in reaching an elite position in private enterprises, politics, justice or science. The social class of the parents is most important in careers within private enterprises but less so in scientific careers where Ph.D. candidates from working class families have better chances than those in other sectors. The comparison of cohorts, however, led to the conclusion that in times of tense labor markets (when there are fewer high management positions available) working class candidates tend to be displaced by those from a more affluent background.

The theoretical approaches dealing with homophily, taste-based discrimination and statistical discrimination provide reasons to predict an advantage for those from higher social classes. Besides these economic approaches, Bourdieu (1982) explains the mechanisms of social reproduction: To obtain exclusive titles in the educational system is a fundamental requirement for being eligible for elite positions. Bourdieu et al. (1981) described the meaning of habitus for the reproduction of social structures. Offspring of the upper middle and upper classes innately understand appropriate behavior in higher positions. In an empirical study Hartmann (2002) confirmed that those from Ph.D. cohorts who had affluent family backgrounds more often reached higher positions in academia, politics, judiciary or economy. Accordingly, the habitus of a person coined by social origin leads to corresponding social positions. We investigate the hypothesis:

H3: People from a higher class of social background have better chances of becoming associate or full professors.

We will not consider ethnicity in our analysis. Ethnic differences in school achievement are discussed in detail in educational sociology. Nevertheless, the group of minority members among our population is too small for investigation with quantitative data analysis techniques.

At the beginning of this section, we argued that ascriptive characteristics might correlate with performance, thus explaining lower rates of success. Another mechanism that might explain why women or people from lower social classes are underrepresented among elite positions in science is their lower social and institutional capital.

2.3 Social Capital in Academia

Network and social capital theories focus on the effects of social structures. Granovetter (1973, 1983) argues that weak ties have advantages for acquiring new information, because acquaintances (weak ties) are less likely to know each other than friends and family (strong ties). Therefore, acquaintances are more likely than friends and family to offer non-redundant information. Although information on job openings in academic institutions is usually public, via social networks information about implicit criteria and tacit knowledge may also be available. Having numerous weak ties also increases the likelihood of being connected to persons of higher status (Lin et al. 1981).

H4: The number of weak ties in the academic social network increases the chances of success.

Burt (1995, 2006) extended the weak ties thesis arguing that people with brokerage functions bridge a structural hole in a social network, connecting subgroups which would otherwise be disconnected. Therefore the broker not only receives non-redundant information (analogous to the strength-of-weak-ties argument) but can also control the information flow between the two subgroups.

H5: When a person has a brokerage position, the chances of success are higher.

Wegener (1987) criticized Granovetter’s weak ties thesis. He argued that people with high status do not gain as much from weak ties because these ties more often link them to people with lower status. Additionally, a dense network including only a few
structural holes may be advantageous, too. Belonging to a group of scientists who are dealing with similar research questions is another kind of social capital. Discussion within a work unit or an institute may be beneficial for young researchers, too. Members of these groups may publish together, cite each other’s work (Lang & Neyer 2004), organize workshops or conferences or read and discuss their manuscripts.

Another dimension of social capital in academic careers is mentorship. Mentors seem to be enormously important for young scientists (Zuckerman 1977, 1993). More than half of the Nobel Prize laureates had themselves been mentored by one or more other Nobel Prize laureates (Zuckerman 1977). Young and ambitious scientists search for renowned senior colleagues, and, conversely, possible mentors select talented persons for cooperation. The advantages of working together with successful scientists are not restricted to contents but include the dissemination of tacit knowledge (Zuckerman 1977; Long & McGinnis 1985; Leahey 2006; Gross & Jungbauer-Gans 2007). Having worked together with a renowned senior colleague correlates with early productivity (Long & McGinnis 1985; Long 1990), high satisfaction with earnings and occupational careers (Melicher 2000) and the achievement of high positions such as head of department (Sabatier et al. 2006). When a young scientist has a mentor, she/he can borrow some of her/his social capital and receive valuable knowledge. Not only the number of mentors but also their reputation in the scientific community may make a difference. The larger the social network of the mentor and the higher her/his reputation, the more benefits the mentee may gain from this relationship (assuming the mentor behaves cooperatively). Two social mechanisms lie behind the benefits: First, the mentee derives a higher rank prestige from a well-connected mentor (Newman 2004) which means that she or he can reach a larger social network via this link. This argument is linked up with the reasoning by Lin et al. (1981a, 1981b) that not only the number of weak ties but also the possibility of being indirectly connected to people with higher social status is important. Secondly, if the mentees of highly productive and successful mentors are ascribed high productivity, too, a signaling effect may occur. Therefore, we assume that the existence of a mentor with a high reputation is beneficial.

\textit{H6a: Having a mentor with a high reputation increases the chances of success.}

\textit{H6b: Working intensively with a mentor leads to better chances of success.}

A further dimension of social capital is to be found in private life. Social and emotional support such as a supportive spouse who takes care of the children and household tasks can provide a young scientist more time to do research. Fox et al. (2011) investigated family and work conflict in academic science. They found that women report significantly higher interference of both family on work and work on family than do men. Rusconi & Solga (2012; see also Rusconi 2011) found inferior chances in technical and social sciences for women with children to pursue their careers but almost no gender differences in natural sciences. Men and women without children have quite similar chances in all disciplines. Studies investigating the age of men and women at each step in their scientific careers show that women are younger at earlier stages (graduation, Ph.D.), but later on they need more time to achieve their habilitation or to be appointed as professor (Kimmer et al. 2003). Survey data find that among professors more men than women are married. If they have children, male professors in the overwhelming majority rely on their partners to take care of them whereas female professors use paid personnel, day-care centers, shared responsibility with their partners or undertake the care themselves in similar proportions (Kimmer et al. 2003). Women adopting traditional roles are less successful (Althaber et al. 2011). Therefore, it is crucial to control for social support when analyzing gender differences. The following hypothesis is derived from these arguments:

\textit{H7: The more private social support a person receives, the higher is his/her productivity and success.}

Depending on the division of household work and career support from partners, marital status might foster or hinder academic careers of women. Recent research on dual career couples in academia investigates whether women have advantages or disadvantages from having a partner in academia or even the same discipline (Hess et al. 2011; Rusconi 2011; Rusconi & Solga 2012). They expect that problems occur after the Ph.D., especially for women, in coordinating extra requirements such as study group leadership and temporary employment abroad as well as finding two jobs in the same region or even with the same employer. However, only a few of the effects investigated can be confirmed. Women in natural sciences with a partner in academia or in the same discipline have a higher rate of achieving their habilitation (Hess et al. 2011). A person’s level of achievement before the habilitation in these scientific careers is not affected...
as much by having a partner in the same profession.

At least some of the value of social capital is that it leads to better performance and higher productivity (Klenk et al. 2010). Additionally, there might be a direct effect of social capital on success that cannot be explained by higher productivity. Mentors with high individual reputation lead to high visibility of the whole institution they belong to (Burris 2004). As social capital in some respects overlaps with institutional capital, the interesting question is, after controlling for institutional capital, how much social capital influences a person’s chances for success.

2.4 Institutional Capital

Institutional capital represents resources that lie within the reputation of institutions. Universities and research institutions obtain a reputation from the past success of their faculty. A high reputation results in highly competitive admission criteria for students. Academic grades that have been earned from renowned, large, or old institutions can further the career chances (Manis 1951; Cohen 1993).

Burris (2004) argues that American elite institutions reproduce their high status by hiring Ph.D.s from other elite institutions. Unlike the U.S., Germany does not have a tradition in ranking universities according to their quality and reputation. However, in each discipline an implicit ranking has existed, known by most members of the discipline. Institutions with a high reputation attract highly productive or well-known faculty. Therefore, young researchers at these institutions encounter the best researchers and may profit from their advice. Fiedler et al. (2008) showed that the productivity of young scholars is positively correlated to their mentor’s productivity. This result can be interpreted in terms of jointly-used resources, stimulating work environments or scientific socialization to similar habits.

Another advantage of a large or well-known university may be better working conditions such as a stimulating work climate, good libraries, and research facilities. These institutions can more easily acquire further resources such as research grants (Rose 1986; Auspurg et al. 2008) or attract scholars from abroad for visits and cooperation. Empirical results have proved the effect of this context on scientific productivity. The effect of the institutional prestige on the productivity of researchers is larger than the reverse effect (Long 1978; Long & McGinnis 1981; Fox 1983; Allison & Long 1990). The prestige of a new employer correlates positively with the prestige of the prior job and the doctoral department (Allison & Long 1987; Judge et al. 2004). Schlinghoff (2002) analyzed the influences of productivity and the reputation of German economics and business departments on the chances of receiving a chair. His main conclusion is that scientific productivity is most important. Dey et al. (1997) found accumulative advantages — thus supplying evidence for a Matthew effect among institutions (Merton 1968, 1988) — as well as institutional isomorphism in the productivity of institutions. ³ Self-enforcing mechanisms can explain the accumulation of advantages in highly regarded departments: Talented persons are accepted at the best graduate schools, they prefer to work with eminent scholars at institutions with high reputation and receive additional training by their teachers (Crane 1965). Renowned institutions more often host the editors of important journals. An empirical study found an in-house-editorship effect (Stahl et al. 1988) meaning that the chances of publishing are higher for those from the department editing the journal than for those from other institutions. Simple explanations for the in-house-editorship effect are the knowledge of implicit criteria for acceptance and editorial policy as well as mutual help among collaborating colleagues to ensure the quality of papers. Again, we expect the success rate of applicants for positions in academia to be directly and indirectly affected. Institutional capital is suitable for promoting the productivity of young researchers, which is what is meant by its indirect effect on success. If there is still an effect of indicators of institutional capital on the careers of young researchers after productivity measures are controlled, we could prove a direct effect from institutional capital. This direct effect of institutional capital is comparable to signaling mechanisms that have been discussed in labor market theory (Spence 1973, 1974). We derive the following hypothesis:

³ The Matthew effect describes processes in which persons with already high reputation accrue greater recognition for an additional piece of work than not so well known scientists (Merton 1968). Although at first described for individuals, the effect is also applied to institutions as well to express the principle of cumulative advantages in stratified systems. The concept of institutional isomorphism was developed by Riesman (1925) who observed that educational institutions imitated the behavior of other successful institutions in their field.
H8: The higher the institutional capital of the university where the young researcher has been awarded her/his habilitation, the higher is her/his success.

The theoretical framework guiding the research is summarized in figure 1. We analyze the determinants of success in academic careers of young researchers who already fulfill the criteria to be eligible for a chair. In the center of the theoretical model are indicators of productivity and achievement. We investigate the effects of ascriptive characteristics such as gender and social origin, social capital and institutional capital on success. Additionally, we include indirect effects and account for interdependences between the different theoretical constructs in our statistical models while controlling for them.

During the time span when the respondents of our study were in the labor market, their opportunities changed considerably. The German reunification in 1990 increased the number of job opportunities in academia, which produced vacancy chains. Therefore, we control the opportunity structure in the labor market in the statistical model. Additionally, the specialty might influence the opportunity structure in mathematics. Applied mathematics is known to have very good job opportunities in the labor market outside of academia, a fact that might increase opportunities in academia, too.

4 The term vacancy chain was developed by White (1970) for mobility processes within organizations and has been extended to other markets. Individual chances of promotion depend on the structure of the (internal) labor market. One job opening is followed by a chain of openings, because people move one after the other each leaving another vacancy.

5 A similar study of success in the academic labor market for economists found remarkable effects of time (Heining et al. 2007). However, their data suffer from the survivor bias since they do not include cohort members that had already left the academic labor market when comparing young scholars’ and professors’ productivity.
3 Data and Methods

In the following, we use data from habilitation cohorts in three different disciplines, namely mathematics, law and sociology, who received their habilitation degree from 1985 to 2005 at West German universities. To concentrate on the influence of institutional, social and human capital on scientific careers – but not so much individual motivation or family reasons – we selected a late stage in academic careers to define the basic population of the study. Due to limited resources only three disciplines have been selected to represent a wide range of subjects and disciplinary cultures. In a first attempt, mechanical engineering was also selected, but the analysis of statistical figures and expert interviews showed that habilitations were much less common in this field. The postdoctoral lecture qualification (habilitation) used to be necessary (and still is in many disciplines) for the promotion to associate or full professor in most of the disciplines in German academia. As a habilitation is only rewarded during an academic career, non-academic positions are normally not preferred by the respondents. Apart from that, many positions with high reputations in the field of judicature are only available to full professors.

The German Research Foundation (DFG, JU 414/7–1) granted the project. Before the questionnaire was developed, in-depth interviews were conducted to collect information about productivity and selection criteria in each discipline (see Gross et al. 2008).

In the following, all mathematics, law and sociology departments in West Germany were asked which candidates had passed a habilitation during the time span 1985 to 2005 at their institution. We searched for new e-mail or mailing addresses of these people in a very time consuming effort. Respondents could answer either by online survey or by printing the pdf-format questionnaire attached to the e-mail, filling it in by pen and posting it back completely anonymously. People for whom no e-mail address was available, but who had a mailing address, received a printed questionnaire. All sampled individuals received one reminder to participate either via e-mail or via postcard. The questionnaire was answered by 716 people in law (n = 233), mathematics (n = 313) and sociology (n = 170). The overall response rate adjusted for neutral non-response (such as wrong address or wrong person) is 45 % and differs by discipline with 40 % for law, 50 % for mathematics and 49 % for sociology. The response rates are satisfying insofar as the respondents all belong to a group of people who are generally underrepresented in population surveys (highly educated and with high occupational status) and considering the fact that online surveys don’t get very high response rates. The main survey was conducted in March and April 2008.

The outcome is described by the duration measured in months from habilitation until one of the following: (a) a promotion to associate or full professorship, (b) giving up applying for such a position (we asked respondents whether they were still applying for these positions and, if they were not, when they had put in their last application) or (c) the date of response to this survey. Considering the successful people only, the male candidates send on average 22 applications, female candidates 14 applications (difference is significant with p < 0.001), and people of both genders received on average 5 invitations to a job interview about 2.5 list placements (meaning that they are usually under the top 3 candidates) and one placement on the top of the list (meaning favored candidate). There are a few exceptional cases (2 % of the sample) in which people passed their habilitation after being appointed as a professor. Most of these people were appointed shortly before they passed habilitation, so we set the duration between habilitation and appointment for these special cases to zero.

For analyzing success in the labor market the study should make sure that the data does not suffer from a survivor bias. The presumption that only those who were successful would take part in the survey

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6 We decided not to include East German universities in the study. The process of the German reunification caused a lot of evaluation processes and turmoil in the first half of the 1990s, so that careers at universities during this time largely reflect these institutional changes.

7 Due to these different disciplinary cultures, we expect a high importance of standardized measures of productivity in mathematics; individual characteristics such as social origin should be crucial in a traditional, hierarchically structured discipline like law but not so much in sociology.

8 In a few cases, where the respondents had no e-mail address – in particular older respondents and jurists – the questionnaires were posted with a stamped return envelope.

9 Some of the respondents remarked that absolute anonymity cannot be ensured because of the very detailed questions about date and university of habilitation, doctorate etc. Taking into account the importance of this information (e.g., to determine the institutional prestige) we accepted this minor flaw.
was tested empirically. We drew a random sample of 173 people (about 60 per discipline) from our addresses and tried to find out for each person at which position she/he was currently working to evaluate whether those who did not reach a professorship more often declined to take part in our study. The comparison of the sample data with the data from our survey showed that the proportions of people in professors’ positions do not differ: No significant differences were found on 10 %-level, which indicates that there is no success-bias for participation in the survey. The argument, however, that only successful women took part in our survey can be refuted with a t-value of –0.12, which is far from being significant.

At a first glance the data show that the median ages at which the stages of the scientific careers are passed differ between the three disciplines (see Figure 2). The median ages at which a Ph.D. or a habilitation is awarded are lower for mathematicians than for jurists. The highest median age among the three groups at time of receiving a Ph.D. or habilitation is awarded are lower for mathematicians than for jurists. The highest median age among the three groups at time of receiving a Ph.D. or habilitation is awarded are lower for mathematicians than for jurists. The highest median age among the three groups at time of receiving a Ph.D. or habilitation is awarded are lower for mathematicians than for jurists. The highest median age among the three groups at time of receiving a Ph.D. or habilitation is awarded are lower for mathematicians than for jurists. The highest median age among the three groups at time of receiving a Ph.D. or habilitation is awarded are lower for mathematicians than for jurists.

For data analyses, we applied event-history techniques, which account for the censored data structure. A graphical representation of the Kaplan-Meier survival estimates (also known as product-limit estimation) gives a good first impression of the survival rates by discipline (see Figure 1). All cases start at time episode 0 (meaning the time, when the habilitation has been achieved) and are subsequently “at-risk” to be appointed to a chair. The y-axis shows the survival rate, that is the proportion of the sample still being “at-risk” i.e. the proportion still applying for a chair.10

The third figure reflects the importance of the discipline in analyzing the application process. Unlike mathematics and sociology, candidates from law have the best chances of being appointed to a professorship shortly after their habilitation. The median times are 19 months in law and 59 months in mathematics and sociology.

For testing the research hypotheses the semi-parametric Cox proportional hazard model was used (Cox 1972). This model presumes that the covariates multiplicatively vary the baseline hazard function, whereas the baseline hazard rate \( h_0(t) \) itself remains unspecified. The hazard rate for the \( j^{th} \) subject is stated by the function

\[
\hat{h}(t | x_j) = h_0(t) \exp(x_j \beta) \tag{1}
\]

whereupon the coefficients \( \beta \) are to be estimated from the data. No assumptions were made concerning the shape of the hazard rate over time, but the effects of the covariates are asserted to be constant over time (e.g., Blossfeld et al. 2007: 223). To test the proportional hazard assumption a link test was used, which is strongly recommended by Cleves et al. (2004: 175). When comparing subject \( j \) and \( m \)

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10 For further information concerning Kaplan-Meier survival estimates see, e.g., Blossfeld et al. 2007: Chap. 3.
the hazard of one subject is given by a multiplicative value of the other. Namely, the model assumes that

$$\frac{h(t|x_i)}{h(t|x_m)} = \frac{\exp(\gamma_i \beta_x)}{\exp(\gamma_m \beta_x)}$$ (2)

which is constant over time as the covariates, too, do not change. Parametric models – estimating the time dependencies of the transition rate – were tested additionally (see, e.g., Blossfeld & Rohwer 2002: Chap. 7). These results do not differ very much from those of the Cox proportional hazard model. The data analysis was conducted using Stata 11.

To solve the problem of missing data among independent variables, multiple imputations have been computed using the ICE ado in Stata. We did not estimate the values when information on the dependent variables (duration in month and status) was missing. Therefore, the number of cases in the analysis must be reduced by the number of cases with missing dependent variables.

Information about the measurement of variables is summarized in Table A1 in the appendix. Dummy variables for time periods are inserted to control for the opportunity structure in the academic labor.

A more direct operationalization of the number of job openings in each discipline unfortunately is not possible.12

All respondents received the same questionnaire, but some items applied only in a particular discipline: The number of publications in SCI-Journals is of no importance in the field of law, as most of the respondents in this discipline did not even know what the SCI is. Similarly, the research orientation (applied versus theoretical) only makes sense for mathematics.

The occupational prestige of parents was derived from a detailed question about their job positions (highest of either father or mother) and was ranked using the occupation subscale provided by Winkler & Stolzenberg (1999), which is interpreted as metric. Years of education were computed from the highest examination that father or mother of the respondent obtained.

11 Whether significance testing is appropriate in case of complete sampling, is discussed in the literature (e.g., Broscheid & Gschwend 2003). We argue that our data are characterized by measuring errors and that the observations are distributed identically and independently. Therefore, significance tests may be used to determine whether the hypotheses have to be rejected.

12 The Federal Statistical Office provides data of first appointments to a professor’s position not earlier than 2000. Periodicals such as the newsletter of the German professional association of university teachers or the Deutsche Universitätszeitung provide only incomplete samples of advertisements that moreover do not cover the whole two decades. We inspected the transition rates for each discipline by calendar year to define the range of the dummy variables to be used as proxies for the opportunity structure of the academic labor market. This analysis yielded the result that the rates by year are relatively stable in each discipline after 1995. Therefore, we decided to use only one dummy variable that distinguishes the two decades.
The productivity in the time span before habilitation is measured by the log of the total number of publications, the log of the papers published in journals included in the (social) SCI (not for law) and the proportion of workload dedicated to research but not teaching or administration. All these publication measures were self-reported. The number of all publications is usually taken as a proxy for quantity whereas the number of SCI-publications should indicate quality of publications. The age at the completion of the habilitation should account for the fact that performance is measured by work done in a particular time span. An additional control variable to adjust for a favorable labor market outside academia is the dummy variable applied mathematics (not used for law and sociology). The meaning of applied mathematics is discussed in detail in a former publication (see Gross et al. 2008).

To evaluate the number of weak ties (log) the respondents were asked to report the number of people from whom they received information on job openings in academia. A brokerage position occurs in cases where the respondent believes that two out of three people giving information on job openings do not know each other. Having a mentor with a high reputation was measured by a standardized index from three items that said: ‘My mentor has a high reputation in the scientific community.’ ‘My mentor has plenty of contacts in the scientific community.’ and ‘My mentor often introduced me to her/his contacts.’ This variable might be biased by social desirability. However, due to the obligation to observe confidentiality we did not ask respondents about the names of their mentors, information which could have been used to collect more valid data about their scientific productivity or reputation. Another variable takes into account whether the respondent often published together with her/his mentor. Two further variables were used to describe private social capital: first, being married at time of habilitation; and second, the proportion of household work, by percentage, that was done by respondents indicating less support. The proportion of household work is highly correlated with the proportion of time spent with children, so we decided to use only the first measure as its explanatory power is higher.

Institutional capital was measured by three indicators: first, by an appraisal of the reputation of the university where the habilitation was awarded by the respondent her/himself; second, by the size of this university indicating its visibility and tradition; and third, by the strength of the institution in acquiring research funds using the ranking of the German Science Foundation. This variable equals one if the department belongs to the top 20 departments in Germany. The descriptive statistics of the variables are summarized in Table A2 in the online appendix (www.zfs-online.org).

4 Results

What influences the chances of success in the academic labor market? To investigate this question, we estimated Cox proportional hazard models. Each model contains a dummy variable for the habilitation cohort (as most important control variable) and gender as it is correlated with other covariates (such as share of total workload spent on research, number of publications in journals included in the SCI, percentage of household work). We incorporate several groups of variables step by step into the models for each discipline while keeping the promising variables (with an absolute t-value greater 1.3, t-values are not shown in the tables) of the previous models. We begin with personal determinants (model 1), then we add human capital and productivity (model 2), academic and private social capital (model 3) and institutional capital (model 4; for models 1–5 see Tables A3–A5 in the online appendix). In model 5, we then show the reduced models containing variables with high t-values (besides habilitation cohort and gender; see also Table 1). To evaluate the explanatory power of these models, the likelihood ratios are mentioned at the bottom of the tables. Additionally, the number of complete cases with no imputed values for these models is given. The hazard ratios can be interpreted as being multiplicative, i.e. a coefficient greater than 1 increases the chance for a promotion whereas a coefficient smaller than 1 decreases these chance. The standard errors for the hazard ratio are

13 We decided against using time spent in academia as it is difficult to specify the correct starting point: time of the first work contract at an university, time of the final degree, the beginning of the doctorate, etc.
14 For law and sociology we have not found a comparable short item indicating the opportunity structure outside academia.
15 Being married might have a positive effect for men and a negative for women, if traditional role models are adhered to.
16 The likelihood ratios were computed from models not using multiple imputations, as they are not provided in the model estimations including multiple imputations.
not calculated as in other models (coefficient/standard error=t-value), so one cannot draw conclusions from the hazard ratio and standard error to the significance level (see Cleves et al. 2004: 132f.).

In mathematics, neither habilitation cohort nor gender influence the chances of becoming a professor. However, social origin seems to be of some importance. Higher occupational prestige of the parents increases the chance of promotion. After the variable years of education of the parents is excluded from the model (due to multicollinearity), the effect of higher occupational prestige is significant at a level of 5 percent.

Contrary to our expectations, the number of all publications or the number of publications in journals that are listed in the science citation index (SCI) do not have a significant effect on the hazard rate. The chances of promotion, however, decrease with higher age during the habilitation and increase with the proportion of time spent on doing research and with the specialization in applied mathematics in comparison to theoretical mathematics.17 Neither the size of a candidate’s social network of weak ties nor being in a brokerage position has a significant effect on the chance of being appointed to a chair. Having a mentor who is well esteemed is one of the most important determinants of academic success; however, to publish together with a mentor tends to be disadvantageous in mathematics. An explanation for this effect could be the Matthew effect that ascribes the achievements to the senior co-author. A puzzling result is found for private social capital: Being married reduces (!) the chances of success in mathematics significantly, which contradicts the hypotheses of the supporting effect of private social capital. The workload for household tasks has no effect. In the fourth model in Table A3, institutional capital is the focus. None of the variables measuring institutional capital has a significant effect. The last model summarizes the most important determinants of success in mathematics (this model is summarized in Table 1).

In law, the cohorts from the years 1996 to 2008 experience fewer chances than those who passed their habilitation in the first decade covered in our study. This result may be due to the restructuring of East German universities that took place in the first half of the 1990s leading to more opportunities for those cohorts seeking a position in the academic labor market. In particular in the field of law, institutions were evaluated, causing the closure of some institutions and the founding of some new ones, which provided new positions to be filled.

Again gender has no effect, although social origin is important here, too. In the case of law, the parents’ years of education show a more considerable benefit than their occupational prestige. Concerning human capital and productivity, the number of all publications and the workload dedicated to scientific research has no significant effect but are kept in the model due to absolute t-values greater than 1.3. When social capital is controlled for, the number of all publications is at least significant on the 10 %-level. As in mathematics, it is beneficial in law to achieve the habilitation at an early age, which has a significant effect.

Attributes of the academic social network show no effect whereas having a mentor with a high reputation is beneficial in law, too. Unlike in mathematics, it is slightly advantageous in law to publish together with the mentor. The models for law show very little effect aside from social origin and scientific productivity.

In sociology, the data show no effects of social origin. However, gender leads to an interesting result: After controlling for social and institutional capital, women have even better chances than men of becoming professors. This result is discussed at the end of this section in greater detail.

With respect to human capital and productivity (model 3 in Table A5), the number of publications in journals listed in the SCI has the most important effect followed by the age when the habilitation is awarded. We did not expect that the overall number of publications would be much less important than SCI-publications, since there is a considerable discussion within the discipline – especially in the parts dealing with subjects in culture, arts and humanities – on how important internationally recognized peer-reviewed journals should be for evaluating scientific success.

With respect to social and institutional capital, only two effects should be mentioned: Respondents having a large share of the household tasks are slightly disadvantaged in law and sociology; and a weak but not significant tendency can be found, that achieving the habilitation in a university which is one of the top 20 in the research ranking of the German Research Foundation tends to be advantageous.

In Table 1 the condensed models from all three disciplines are summarized. Our first hypothesis that human capital and productivity are important for

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17 A similar variable cannot be included in the models for sociology or law.
scientific careers is confirmed. However, the specific indicator representing productivity in the three disciplines differs considerably. Only the age at which habilitation is awarded has a significant and robust effect in all three disciplines. In mathematics, the specialization of applied mathematics and the research workload are the central indicators; in law, the total number of publications shows a weak effect; and in sociology, the number of publications in SCI-journals is beneficial.

Moreover, expected gender effects were not found: Women are not disadvantaged in the academic labor market (hypothesis 2 is not confirmed). In sociology, women (who face the same situation concerning productivity, social capital and the habilitation cohort as men) have even better chances than men of being appointed to a chair. One explanation may be the implementation of chairs with the specialization for gender studies as a field mainly pursued by women. The reason why women are still underrepresented in the academic elite is (a) that they do not face the same factors men do (women are at a disadvantage regarding the share of time they spend for research, are less likely to publish together with their mentors and spend more time with their children and household activities) and (b) the gender selectivity (possibly forced by direct or indirect discrimination against women) works in earlier career stages and only very few women (at least in the habilitation cohorts 1985–2005) are left in this stage. Results from other studies showed that a larger proportion of women than men leave academia on their way from graduation to Ph.D. and habilitation, which might result in a more selective population of women who arrive at the later stages of academic careers. The policies presently in place that are meant to increase the share of female professors may help these few women who are left, but, according to our results, gender policies should concentrate on earlier stages in academic careers.

The third hypothesis deals with the influence of social origin. From numerous studies in sociology of education, we know that education and occupa-
tional prestige of parents are important for educational decisions and achievements. In the field of sociology in which a lot of people have a relatively low socioeconomic parental background, social origin is of no importance. In law and mathematics, either the occupational prestige or years of education of parents have a significant influence on career chances.

The next hypotheses concentrate on analyzing social capital. Neither the number of weak ties (hypothesis 4) nor having a brokerage position (hypothesis 5) gives a candidate better job opportunities, which contradicts Granovetter’s strength-of-weak-ties argument and Burt’s structural hole approach. The reason therefore might originate in the transparency of the German academic labor market. Each open professor position must be announced in standard journals and there seems to be no great benefit of information circulating in the social network. Mentorship appears to be important in mathematics and law. Mathematicians who are supported by a mentor with a strong reputation have considerably better chances of becoming professors (hypothesis 6a). However, they should not publish together with their mentor since this slightly reduces their chances (hypothesis 6b). In law, a well-known mentor is important, too, but publishing together also seems to be slightly beneficial. This result might refer to different publication cultures in mathematics and law. In law, where blind peer-review is unusual and being a part of the “old boys’ network” (Gross et al. 2008) is important, the cooperation with the mentor might lead to publication in good publishing houses or prestigious journals. In mathematics, where most publications undergo blind peer-review, a well-known co-author might be of no help for the chances of publication, but a prestigious author might take greater credit for the performed work.

Hypothesis 7 argues that private social support furthers academic careers. This hypothesis is only partly confirmed by the result that having responsibility for a large portion of tasks in the home lowers the probability of a transition to a professor’s position to a small extent in sociology and law. Apart from an explanation referring to household economics, the proportion of household tasks may serve as an indicator for a level of personal emancipation. A puzzling result, however, is that mathematicians’ chances of success diminish due to being married. In Germany, an exchange between earning opportunities in the labor market outside academia and the more self-determined labor conditions within academia exists in a number of disciplines. Since the estimated models do not take into account attractive job opportunities outside academia, the negative marriage effect could be due to the decision to leave the academic labor market for better earning opportunities. This behavior, too, could be a reason for a marriage premium in wages that has been confirmed in a couple of empirical studies. However, in our sample of mathematicians only three people who did not get a chair and who were married report being better paid than a professor. As a result, the empirical testing of this presumption is not feasible due to the small number of cases.

Our last hypothesis 8 argues that institutional capital is beneficial for academic careers. None of the indicators measuring institutional capital has a significant effect on the career chances of those applying for a professorship. This may prove Münch’s thesis (2007) that efforts to implement more stratification among German universities by the introduction of the title elite university have not been rewarding actual scientific success. The title has been awarded in a competition for grants to found extensive interdisciplinary research clusters. Münch argues that this competition – widely discussed in the media – has created a superficial structure that does not reflect real success in research as measured by grants received through other means or by productivity in terms of publications. A follow-up study investigating the opportunity for those people aiming for a career in academia nowadays could shed some light on the question of whether or not the newly established hierarchy in German academia has had an effect on the achievements of the respectively decorated universities and their employees.

5 Discussion

In this contribution, we have analyzed the determinants of success in careers in the German academic labor market in three selected disciplines (law, mathematic, and sociology). To our knowledge, there is only one study by Schulze et al. (2008) that also uses cohorts of persons who gained a habilitation. This study capitalizes on economic and business sciences. Most other studies suffer from the survivor bias and include only successful persons (e.g., Heining et al. 2007; Graber et al. 2008). Therefore, these studies have not been able to reveal the determinants of career success. Recently, researchers have been particularly concerned with the effect of productivity on scientific careers in
economics and business management. As with these studies (Schlinghoff 2002; Heining et al. 2007; Schulze et al. 2008), we also found the expected effects of productivity; however, there seem to be marked differences between disciplines with respect to the kind of publications that are most highly valued. Our analysis indicates that, in mathematics and law, being supported by a respectable mentor correlates with better career outcomes. However, to publish papers together with a mentor reduces chances in mathematics. In law, this effect tends to be positive.

The results from our survey show no evidence for an effect of institutional capital. An explanation for this result could be that our operationalization is not valid and that other measures of institutional capital should be used. We could eventually include additional institutions a person was affiliated with during her/his academic career and not only the university where the habilitation was awarded. A second explanation is that institutional capital is confounded with social capital when the reputation of the candidates’ mentors is included into the estimated model. But in our data, there is only a very weak confoundment: Deleting the mentor variables does not lead to significant effects of institutional capital on individual success (see also Schlinghoff 2002). A third explanation is that although the efforts of establishing a prestige hierarchy among German universities may prove fruitful within the next few years, prestige differences were not as salient during the last twenty years.

The results additionally show that the selection processes taking place during academic careers differ between disciplines. In law, more than 80 percent of all people with a habilitation became professors whereas in sociology and mathematics only about 60 percent achieved this aim in our sample. Former work has demonstrated a briefer time span for the younger habilitation cohort to be appointed to a chair (Jungbauer-Gans & Gross 2012).

Regarding our data, it could be argued that we did not collect publication data in a non-reactive way from electronic databases or from the most important journals in each discipline; however, we do not think that this kind of data would be much more valid than self-reported publication numbers because the databases are incomplete and do not cover all three selected disciplines in the same way. Studies that used rosters tried to apply some weighting procedures for evaluating the quality of the paper by using journal-ranking information (Schulze et al. 2008; Fiedler et al. 2008). Additionally, most of our respondents answered the questionnaire anonymously. Linking process data with survey data would have required a re-identification of persons that we did not wish to conduct for ethical reasons.

As already mentioned, the kind of indicator that is most appropriate for measuring productivity and human capital differs considerably between the three disciplines which we have been investigating. Future research should focus on these differences between disciplines and on explaining why, for example, a strong mentor is beneficial in mathematics but not in sociology.

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**Appendix**

**Table A1 Measurement of Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunity structure</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Personal characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0 = male, 1 = female</td>
</tr>
<tr>
<td>Occupational prestige of parents</td>
<td>Highest occupational position of parents following the occupation sub-scale in Winkler’s and Stolzenberg’s (1999) social class index, Range: 0–7</td>
</tr>
<tr>
<td>Years of education of parents</td>
<td>Years of education (highest of either mother or father)</td>
</tr>
<tr>
<td><strong>Human capital and productivity</strong></td>
<td></td>
</tr>
<tr>
<td># publications (all) log</td>
<td>Log of the total number of publications before habilitation</td>
</tr>
<tr>
<td># publications (SCI) log</td>
<td>Log of the number of papers in journals included in the ‘Science Citation Index’ (not used in law)</td>
</tr>
</tbody>
</table>
Table A1 (Continue)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at habilitation</td>
<td>Age at completion of habilitation</td>
</tr>
<tr>
<td>Research (%) workload</td>
<td>Proportion of workload that was used for research during the time between dissertation and habilitation (not for teaching, reviewing or administration; 0–100 %)</td>
</tr>
<tr>
<td>Applied mathematics</td>
<td>Recode of 5-point scale from 1 = very applied to 5 = few applied, 0 = few applied to neither nor (3, 4 and 5), 1=very applied and applied mathematics (1 and 2) (not used in sociology or law)</td>
</tr>
<tr>
<td>Academic social capital</td>
<td># weak ties (log)</td>
</tr>
<tr>
<td></td>
<td>Number of persons: “From how many persons did you receive information about job openings at universities after your habilitation?”</td>
</tr>
<tr>
<td>Brokerage position</td>
<td>1 = There is at least one pair of persons among the three most important persons giving information about job openings that did not know each other, 0 = the opposite</td>
</tr>
<tr>
<td>Mentor, high reputation</td>
<td>0-1-standardised index from 3 Items (1–5): “My mentor has a high reputation in the scientific community.” “My mentor has plenty of contacts in the scientific community.” “My mentor often introduced me to her/his contact persons.” (Cronbach’s alpha = 0.75)</td>
</tr>
<tr>
<td>Mentor is co-author</td>
<td>Recode of 5-point scale: “My mentor and I often published together.” (1 = not applicable at all to 5 = very applicable), 0 = not applicable at all or no mentor, 1 = the opposite</td>
</tr>
<tr>
<td>Private social capital</td>
<td>Married</td>
</tr>
<tr>
<td></td>
<td>0 = never married, divorced or widowed at the time of habilitation, 1 = married</td>
</tr>
<tr>
<td>Household (%) total</td>
<td>Proportion of household work that was taken care of by respondent during the time of habilitation (0–100 %)</td>
</tr>
<tr>
<td>Institutional capital</td>
<td>Reputation of habilitation university</td>
</tr>
<tr>
<td></td>
<td>0 = small to rather high reputation, 1 = high reputation of university where habilitation has been awarded (self-reported)</td>
</tr>
<tr>
<td>Size of university</td>
<td>0 = smaller than 25.000 students, 1 = larger than 25.000 students</td>
</tr>
<tr>
<td>DFG research ranking</td>
<td>1 = department ranked among top 20 by German Science Foundation (DFG) in the year 2005 according to the sum of research funding</td>
</tr>
</tbody>
</table>

Tables A2–A5: see online appendix (www.zfs-online.org).

References


Granovetter, M., 1973: The Strength of Weak Ties. The American Journal of Sociology 78: 1360–1380.
Autorenvorstellung


Forschungsschwerpunkte: Diversität in Organisationen, Bildung und Gesundheit, wissenschaftliche Karriereverläufe, soziales Kapital.


Forschungsschwerpunkte: Bildungsoziologie und Wissenschaftsforschung, Medizin- und Gesundheitssoziologie, Methoden der empirischen Sozialforschung, Sozialkapital.