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ARTICLE

Leaky pipeline or glass ceiling? Empirical evidence from the German academic career ladder

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ABSTRACT

Women are underrepresented in leadership positions – academia is no exception. Using data on careers of doctoral graduates in Germany, we study gender differences in the decision to stay at university as a postdoctoral researcher and in the intention to become a professor. We find that gender gaps related to aiming for a professorship can be fully explained by observable characteristics other than gender. On the contrary, even after adding controls for an array of characteristics relevant to academic careers, we find female graduates to be 5.9 percentage points less likely to hold a postdoctoral position which allows them to qualify for professorship.

KEYWORDS

Female labour supply; gender gap; higher education; glass ceiling; leaky pipeline

JEL CLASSIFICATION

I26; J16; J24

I. Introduction

Women are still underrepresented in leadership positions (e.g. Petrongolo 2019), and academia is no exception. For instance, in Germany, the leak in the academic pipeline is apparent: while slightly more women than men have graduated from universities in recent years, the share of women declines with every step of the academic career ladder. In 2019, 45% of all individuals who have received a doctorate in Germany were female. For habilitation, which is a post-doctoral qualification required to obtain a professorship in Germany, the women's share was 31% in the same year. Finally, the share of women among tenured full professors was 26%.[1] Although the gap is slowly closing, this underrepresentation of women means a reduction in the talent pool and hence constitutes a barrier to better economic outcomes (Bertrand 2018).

Prior research has identified psychological attributes, preferences/social norms, and a greater demand for flexibility in the workplace (mainly caused by motherhood) as the most important reasons for the 'glass ceiling' that prevents women from obtaining high-status, high-income jobs (e.g. Bertrand 2018).

Closely related to prior literature that tries to explain gender differences in promotion in the academic labour market such as McDowell, Singell, and Ziliak (1999), Blackaby, Booth, and Frank (2005), and De Paola, Ponzo, and Scoppa (2017), this study uses data on the careers of doctoral graduates in Germany to examine gender differences in the decision to stay at the university as a postdoctoral researcher and to aspire to a professorship. In other words, the data allow us to separate general ambitions from actual positions. We are particularly interested in whether gender imbalances can be fully explained by the characteristics mentioned. In addition, we account for variables previously identified as being relevant to academic careers, such as mentoring and publishing. As a further contribution, decomposition techniques are used to examine how much different sets of covariates contribute to the glass ceiling phenomenon in academia.

II. Materials and methods

The data set

The data set is based on the *Promoviertenpanel 2014* ('Careers of PhD Holders 2014') provided by the German Centre for Higher Education Research

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[1]C.f. Federal Statistical Office of Germany (2019). For other countries, see Catalyst (2020) and references therein.

and Science Studies (DZHW). The *Promoviertenpanel 2014* was funded by the Federal Ministry of Education and Research and designed as a full census of researchers who obtained doctorates during the academic year 2013/14 in Germany, 28,147 individuals altogether. The data was collected via questionnaires in two waves in 2015 (first wave: standardized self-administered survey, sent out to 19,916 individuals, 5,412 responses, net response rate of 27%) and 2016 (second wave: standardized online survey, 4,816 invitations and 3,188 responses, net response rate of 66%).[2]

Top academic career ambitions are surveyed by two questions in the second wave: 'Are you aiming at a professorship?' and 'Are you planning or have you started any of the following scientific qualifications: habilitation, junior professorship, research group leader, scholarship/funding programme'.[3]

From the first question we created a binary variable *professorship* derived from whether the answer for the first question was 'Yes, I am aiming at a professorship' (*professorship* = 1, zero otherwise). From the second question we constructed a binary variable *stay* for choosing a career path that qualifies for a professorship (*stay* = 1, zero otherwise).[4] After discarding non-responses, we were left with 3,036 observations. Although *professorship* does not necessarily require *stay* and vice versa, we observe a considerable overlapping between these groups: 43.18% of those 623 individuals who decided to stay at the university after their doctorate declare that they want to become a professor, and we have *stay* = 1 for 69.51% of 387 individuals with the general ambition to obtain a chair.

Table 1 presents summary statistics for our key variables by gender. For both *professorship* and *stay*, the percentage of women is lower than that of men. The table shows further gender differences, notably in publications, supervisors of the same gender, personality traits, and family status.[5] The data also include information about the field of study. There are 57 different disciplines in our final sample, and frequencies vary between disciplines and between men and women. We control for this in our empirical analysis.

Empirical approach

We estimate the linear probability model

$$Y_i = \beta_0 + \beta_1 FEMALE_i + \gamma' X_1 + \delta' X_2 + \sigma' X_3 + \varepsilon_i, \quad (1)$$

where Y_i is the endogenous outcome of interest ($Y_i = stay_i$: individual i holds or would hold an academic position which would allow them to qualify for a professorship, $Y_i = professorship_i$: individual i aims for a professorship). X_1, X_2, and X_3 are vectors including, respectively, covariates related to demographics (age, native country, parental background, family status including an interaction term *children* × *pHHinc*), the doctorate (grade, duration, form, publications (with and without peer reviews, in collections, books), funding, teaching experience, mentoring (reputation, gender, emotional support), networks, geographical location of the university (federal state)), and personality traits ('The Big Five', self-efficacy, locus of control). Finally, discipline dummies were added to the model.

β_1 then captures the gender effects that cannot be explained by those observable characteristics which have been identified as being important for gender gaps in labour markets in general, and in the academic world in particular. In the next section, we will present conditional and unconditional estimates of β_1. In addition, the importance of any given factor in explaining the outcome variable is quantified using the order-invariant decomposition method proposed by Gelbach (2016).[6]

[2]See the official documentation (accessible via doi.org/10.21249/DZHW:phd2014:2.0.0) and Jaksztat et al. (2017) for further information on the data set. Since the items differ between the two waves, it is not possible to examine within-subject changes over time.

[3]Information on these academic positions can be found on this website maintained by the German Federal Ministry of Education and Research (BMBF): https://tinyurl.com/y7dxflqe.

[4]Note that we also categorized individuals who stated 'I already hold a chair' as *professorship* = 1 when this did not include 'Fachhochschulen' (universities of applied sciences). The reason is that 'Fachhochschulen' aim to qualify their students for a more practical career. Being a professor there requires work experience outside academia and typically does not qualify postdocs for a professorship at a traditional 'academic' university.

[5]For personality traits, individuals were asked to which extent they agree with trait-related statements on a five-point scale (1 = strongly disagree, 5 = strongly agree). Since several statements correspond to each personality trait, we calculate the arithmetic mean across the relevant statements so that our personality trait variable still displays values between one and five.

[6]As a robustness check, we replicate the analysis using a Logit estimator. The main results are unchanged (available upon request).

Table 1. Summary statistics.

	Men		Women		
	Mean	SD	Mean	SD	Definition
Professorship	**0.160**	–	**0.097**	–	'I already have a professorship' or 'Yes, I am aiming at a professorship'.
Stay	**0.238**	–	**0.173**	–	Habilitation, junior professorship, research group leader, scholarship/ funding programme.
Doctorate					
Time	**4.946**	2.061	**4.771**	1.991	Time taken to obtain doctorate.
Grade	**1.950**	0.672	**2.110**	0.749	Final grade (1 (summa cum laude), 2 (magna cum laude), 3 (other)).
Teaching	**2.242**	3.674	**1.639**	3.286	Time spent on teaching (hours per week).
Network	**2.915**	1.182	**2.727**	1.215	Managed to build a large, supportive network (1 (disagree) to 5 (fully agree)).
NetworkInt	**2.897**	1.423	**2.647**	1.487	How much importance was assigned to intern. contacts during PhD? (1 (not at all) to 5 (highly)
Publications	**2.789**	4.651	**1.707**	2.460	Number of peer-reviewed publications.
Reputation	**4.051**	0.938	**3.945**	0.971	Reputation of the main supervisor (1 (low) to 5 (high)).
Samegender	**1.990**	1.264	**0.709**	0.889	Number of supervisors of the same gender.
Supemo	3.297	1.306	3.434	1.373	I always received emotional support from my sci. environment (1 (disagree) to 5 (fully agree)).
Recommendation	**0.889**	-	**0.230**	-	Recommendation to pursue academic career (yes/no).
Docreason	**3.085**	1.191	**2.998**	1.200	Academic career was the reason to start the PhD project (1 (disagree) to 5 (fully agree)).
Demographics					
Age	**35.536**	5.628	**34.426**	5.360	
East	**0.203**	–	**0.247**	–	Living in eastern Germany (yes/ no).
BirthGer	0.908	–	0.901	–	Born in Germany (yes/no).
ParentsGer	0.907	–	0.920	–	Parents born in Germany (yes/ no).
Acadback	**0.645**	–	**0.693**	–	Father or mother has academic degree (yes/no).
pHHinc	**0.345**	–	**0.541**	–	Household shared with full-time working partner (yes/no).
Children	**0.411**	–	**0.342**	–	Children living in the household (yes/no).
Childimp	4.168	1.185	4.192	1.224	Aim in life: own children (1 (disagree) to 5 (fully agree)).
Personality traits					
Extraversion	**3.120**	0.963	**3.392**	0.927	The Big Five personality traits.
Agreeableness	**3.218**	0.732	**3.310**	0.751	
Conscientiousness	**3.948**	0.963	**4.231**	0.679	
Neuroticism	**2.485**	0.826	**2.869**	0.858	
Openness	**3.374**	0.939	**3.527**	0.989	
Self-efficacy	**4.267**	0.554	**4.174**	0.572	
Locus of control	3.065	0.391	3.069	0.415	

Note: N = 3,036 (female share: 0.519). Mean pairs difference: bold $p < 0.05$.

III. Results

Table 2 presents unconditional and conditional estimates of β_1. First, female scientists appear 6.4 percentage points (50.39% of the *professorship* mean) less likely to aim for a professorship (column (1)). Adding our sets of controls reduces the gender gap by 4.1 percentage points, leaving a non-significant 2.3 percentage points gap (column (2)). We conclude from the fact that the estimated coefficient of the gender dummy in the full model is not statistically different from zero that there are no inexplicable gender differences in the ambition to obtain a chair.

Second, we find that on average women in our sample are 6.5 percentage points less likely to *stay* in academia after receiving the doctorate (column (3)). Evaluated at the sample mean of 0.205, this translates into a 32% lower probability for women to follow a career path to professorship. Unlike *professorship*, adding controls reduces the gap by only 0.6 percentage points (column (5)). A gender gap of 5.9 percentage points remains unexplained by observed characteristics. A detailed decomposition of the part of the gap that can be explained by each

Table 2. The gender gap in academic careers.

	professorship		*stay*			
	Base	Full	Base	Full	Diff.	% Expl.
	(1)	(2)	(3)	(4)	(5)	(6)
Female	−0.064**	−0.023	−0.065**	−0.059**	−0.006	−9.89%
	(0.014)	(0.018)	(0.015)	(0.020)		
Additional controls						
Discipline[a]	*no*	*yes*	*no*	*yes*	0.037**	+56.92%
					(0.008)	
Doctorate[b]	*no*	*yes*	*no*	*yes*	−0.042**	−64.62%
					(0.013)	
Demographics[c]	*no*	*yes*	*no*	*yes*	−0.010*	−15.39%
					(0.005)	
Personality traits[d]	*no*	*yes*	*no*	*yes*	−0.003	−4.62%
					(0.005)	
N	3,036	2,497	3,036	2,497		
R^2	0.009	0.225	0.007	0.283		

Notes: Data: DZHZ *Promoviertenpanel 2014*.
Coefficients are estimated in an OLS regression framework.
Robust standard errors in parentheses, * p < 0.05, ** p < 0.01.
[a] : Set of dummy variables accounting for the field of study.
[b] : Grade, duration, form, publications, funding, teaching experience, mentoring (reputation, gender, emotional support), networks, geographical location of the university (federal state).
[c] : Age, native country, parental background, family status.
[d] : The 'Big Five', self-efficacy, locus of control.
The number of observations varies according to differences in non-responses across variables. Using the same sample for all regressions does not yield different estimates of β_1 in (1) and (5) (Chow test, *p*-values 0.314 and 0.313).

of the four covariate sets shows that accounting for potential differences in disciplines even widens the gap by 3.7 percentage points (e.g. because the 'bottleneck' for females differ in size), whereas doctorate-related variables and, to a far lesser extent, covariates related to demographics reduce it.

IV. Conclusion

Female under-representation in top positions is a long-standing phenomenon in academia. Our results from data on the careers of doctoral graduates in Germany suggest that there are barriers for female junior researchers who aim for these positions.

In the case of career goals, these barriers can be identified. That is, the gap can be fully explained by observable characteristics, notably by demographics and doctorate-related variables like publications and the final grade. It appears that variables related to the doctorate/academic experience are most important. Hence, policies aiming at fixing the 'leaky pipeline' should further investigate the reasons for such differences.

However, despite using a large set of controls including characteristics which have been found important for (academic) careers, a gap of 5.9 percentage points with regard to post-doctoral positions (the pool from which future professors are drawn) cannot be explained by our model. Since we are unable to observe the hiring process, we cannot rule out the existence of a 'glass ceiling' in the sense that indirect or anticipated discrimination might play a role.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Bertrand, M. 2018. "Coase Lecture–the Glass Ceiling." *Economica* 85 (338): 205–231. doi:10.1111/ecca.12264.

Blackaby, D., A. L. Booth, and J. Frank. 2005. "Outside Offers and the Gender Pay Gap: Empirical Evidence from the Uk Academic Labour Market." *The Economic Journal* 115 (501): F81–F107. doi:10.1111/j.0013-0133.2005.00973.x.

Catalyst. 2020. "Quick Take: Women in Academia." http://www.catalyst.org/knowledge/women-academia

De Paola, M., M. Ponzo, and V. Scoppa. 2017. "Gender Differences in the Propensity to Apply for Promotion: Evidence from the Italian Scientific Qualification." *Oxford Economic Papers* 69 (4): 986–1009.

Federal Statistical Office of Germany. 2019. "Frauenanteile nach akademischer Laufbahn." https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Tabellen/frauenanteile-akademischelaufbahn.html

Gelbach, J. B. 2016. "When Do Covariates Matter? And Which Ones, and How Much?" *Journal of Labor Economics* 34 (2): 509–543. doi:10.1086/683668.

Jaksztat, S., G. Brandt, S. de Vogel, and K. Briedis. 2017. "Gekommen, um zu bleiben? Die Promotion als Wegbereiter wissenschaftlicher Karrieren." *WSI-Mitteilungen* 70 (5): 321–329. doi:10.5771/0342-300X-2017-5-321.

McDowell, J. M., L. D. Singell, and J. P. Ziliak. 1999. "Cracks in the Glass Ceiling: Gender and Promotion in the Economics Profession." *American Economic Review* 89 (2): 392–396. doi:10.1257/aer.89.2.392.

Petrongolo, B. 2019. "The Gender Gap in Employment and Wages." *Nature Human Behaviour* 3 (4): 316––318. doi:10.1038/s41562-019-0558-x.