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Gender and Academic Rank in the UK

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Abstract: This paper fills in a research gap in what concerns gender and academic rank at UK universities, where women are not far from reaching the 50% share of all academic and research staff, but not even close to reaching such a share at (full) professorial level. Using an ordered logit model and the results of a survey conducted in 2013 with 2270 responses from academics from all fields of knowledge at the 24 Russell Group universities, we find three consistent results. First, being a woman has a negative and significant association with academic rank, except for the case when parenthood is timed with career considerations in mind. Second, the percentage of time spent on teaching and teaching-related activities has a negative and statistically significant association with academic rank. This association is more pronounced in the case of women, who spend a higher percentage of their working time on teaching and teaching-related activities than men, as do those in lower academic ranks. Since women tend to be in lower ranks, the percentage of time spent on teaching and teaching-related activities may be considered both a cause and a result of the gender gap. Third, we find a positive and significant association between the number of children under the age of 18 years and the academic rank of both men and women, as long as babies were timed with career considerations in mind, and a non-significant association when they were not. A possible explanation for this is unlikely to be that children have a positive impact on academic rank, but rather that they arrived after a certain rank had been secured. We conclude with some policy recommendations to help reduce the gender gap.

Keywords: gender discrimination; academic progression; women faculty; female professors; maternity penalty; gender gap

1. Introduction

In 2011/2012, 44.5% of all the academic staff employed at UK Higher Education Institutions were female, yet only 20.3% of professors, which is the highest academic rank in the UK, were women [1]. Focusing on the 24 Russell Group universities in the UK, which are research-intensive universities, in 2011/2012, 40.7% of all academic staff at these 24 universities were female (a share somewhat lower than that at all UK universities) and from all professors only 18.9% were women [2].

Although all universities in the UK value diversity and are committed to equality of opportunity, women are under-represented at senior academic grades. If current trends continue, it will be decades before gender equality at professorial level is reached.

Using an ordered logit model and a new rich and detailed data set, which we collected in 2013, with 2270 observations of academics of both genders at all levels in all fields of knowledge at the 24 Russell Group universities in the UK, we contribute to the literature by examining the association between gender and academic rank, controlling for a number of variables, including but

not limited to, respondent's year of birth, number of children, responsibility for household chores, academic degrees, number of publications, grants, percentage of working time spent on teaching and teaching-related activities, and main area of research. This is timely and relevant, given that the last empirical quantitative study to include UK-based academics of all fields of knowledge was conducted in the year 2000; the results of that study are reported in [3].

We find some results in line with previous work conducted for other countries or for specific fields of knowledge and some novel ones. First, being a woman has a negative association with academic rank, even after controlling for year of birth (i.e., age), marital status, responsibility for household chores, area of research, timing of babies, number of children under the age of 18 years, holding a PhD or not, percentage of working time spent on teaching and teaching-related activities, and a number of research productivity variables. The only case where the variable gender is not significant is when only men and women who timed their children with career considerations in mind are included in the sample. Importantly, we also find that the percentage of time spent on teaching and teaching-related activities, which is higher for women than for men, is negatively associated with academic rank. In addition, and this can be seen as our most important and novel finding, there is a positive association between the number of children under the age of 18 years and the academic rank of both men and women, as long as babies were timed with career considerations in mind. A possible explanation for this is unlikely to be that children help academic career progression, but rather that they arrived after a certain rank had been secured. Timing of children seems to be crucial.

The paper proceeds as follows. Section 2 reviews the most recent and prominent literature on the topic, which, apart from [3], lacks any quantitative study specifically designed for the UK. Section 3 explains how the data were collected. Section 4 presents the model. Section 5 discusses the results. Section 6 concludes and gives some policy recommendations.

2. Previous Work

The potential explanations for the gender imbalance in academia tend to fall under two categories: (a) Women work fewer hours than their male counterparts because their time constraints are more stringent, and as a result progress at a slower rate than men, with a lower percentage making it to the grade of professor; and (b) Women are discriminated against, and inadvertently, denied opportunities that could give them access to high rank positions.

The time constraints hypothesis argues that women need to, want to, or choose to devote time to raising their children and/or taking responsibility for household chores, whilst their male counterparts devote this time to productive work or leisure. The idea is essentially that women with responsibilities for housework and childcare have less energy available for remunerated work than men have, and this affects their job opportunities and productivity [4]. Some authors argue that many high-end jobs require virtually complete commitment to work, and go on to assert that more men than women are prepared to devote themselves to work so fully [5,6]. As a side note, some also hold controversial views regarding innate cognitive and temperamental differences between men and women [5,6]. This topic, however, falls under the remit of sociology, psychology, biology, and related sciences, and is therefore not discussed in the present study.

It has also been argued that women, especially those with children, face more family-work balancing challenges than men [3,7]. A number of studies carried out in different Schools at MIT [8] and a European Commission report [9] also found that family and career tensions were greater for women than for men.

The association between marriage and children and academic rank, salary, and research productivity, however, is far from clear. One study finds that children have a negative effect on academic careers of women and a positive effect on academic careers of men [10]. On somewhat similar lines, another study finds that marriage and young children (under 6 years of age) reduce the probability that women get a tenure-track job [11]. Two further studies find a non-significant association between marriage and promotion, and a positive and significant association between

children and male promotion but a negative, albeit non-significant, association between children and female promotion (in the humanities) (p. 400 [12]) and (p. 51 and p. 62 [13]). Another study finds a positive and significant association between young children and male economists' promotion chances and a negative association between marriage and children and female economists' tenure chances [14]. On the other hand, academics who have older children (aged 6 to 17 years) have been found to have a greater chance of getting tenure, relative to academics without children in this age range, regardless of their gender, probably because children trigger the need to secure ongoing employment [11]. There may also be selection effects because these children were under the age of six years when their parents were completing their doctorates or securing tenure-track positions, and academics, especially women, who manage to do all that whilst simultaneously caring for young children may be especially good at managing their time and the demands of work and family or may have received more support from their partners (p. 400 [11]).

Another study, in turn, finds that having children and having a spouse or partner employed at the same institution are unrelated to tenure and rank among women faculty but having children has a positive association with both tenure and rank for men, who also benefit from being married in terms of their academic rank (p. 301 [15]). Other research finds a positive association between being married or living with a partner and salary [16].

One point that a number of studies find is that academic women are less likely to be married with children, relative to academic men [3,10,13–15], or they are more successful if they delay or forgo marriage and children [11]. It is not clear, however, whether this is a decision women make because they fear that by having children they will jeopardize their careers, even though in reality having children may have made no difference, or whether thanks to the decision of not having children they were able to progress, something they would have not been able to do had they had children. Although intuition would point towards a negative impact of children on the academic progression of women, and this is supported by solid microeconomic theory such as that presented in [4], the evidence, as shown above, is far from conclusive.

Publications are typically considered a key factor for academic progression. In general, publications have a positive association with rank and promotion [13,14,17–20], although there is also some evidence that male economists on tenure-track positions get tenure regardless of their publications (p. 203 [14]). At the same time, on average men produce more publications than women, and this is found across different disciplines [12,14,17,21–28], although the results reported in [13] suggest very small differences.

Women spending more time with their children than men do, especially when they are of preschool age, could potentially be linked to lower publication rates [7,25]. One study, for example, concludes that untenured male economists become substantially more productive after having a first child but female economists with two and three children have, on average, a research record reflecting a loss of two and a half years and four years of research output, respectively, by the time all of their children have reached their teens [28].

On the other hand, a review examining the relationship between marriage, children, and research productivity concludes that there is no evidence of a negative effect of family factors on the research productivity of women (p. 18, p. 99 and p. 189 [29]), in line with [14,27,30,31]. Interestingly, though, another study finds a positive relationship between having children and research productivity for female economists but no relationship for male economists [32]. This same study also finds that women with children are more productive than women without children, as well as some evidence of self-selection that may explain this counterintuitive result: only the most productive women dare to pursue an academic career and have children at the same time [32].

Grants are also typically considered important for promotion, and indeed there is a positive association between grants and promotion [18]. Blake and La Valle [3], whose study actually focuses on grant applications, find that in the five-year period prior to their survey, from those who were eligible to apply, women were less likely than men to have applied for grants, with 56 per cent applying in contrast to 67 per cent of men (p. 36), and women with children were also less likely to have applied

for grants than men with children, with 50 per cent applying in contrast to 62 per cent of men (p. 104). Having said all that, Blake and La Valle find that the success rate for grant applications is virtually the same for men and women and conclude that there is no gender bias in the awarding processes (p. 37 [3]). The main difference between men and women, they argue, "lies in application behaviour rather than in success once applications have been made" (p. 37 [3]). This finding of no gender differences in the outcomes of grant applications is in line with [33–35], but in contrast with [36–39].

Notwithstanding all of the above, lower grant application activity and lower number of publications in absolute and relative terms may be explained not just by time constraints due to housework or childcare but also by time constraints imposed in the very workplace, for example, with higher teaching or administrative workloads [3,18,20,22,23,25,27]. Higher teaching or administrative workloads on women could be the result of subtle discrimination. Needless to say, very rarely is there any blatant open discrimination in academia but a theme that emerges from the literature is that there may be forms of (sometimes unconscious) discrimination that are concealed, almost unnoticeable, and therefore harder to identify. Examples of studies which point towards this unconscious bias against women include [10–13,15,17,19,40], all of which find a gender gap in academic rank or salary, which remains unexplained after controlling for credentials, productivity and/or family circumstances, amongst other variables. One study, however, finds unexplained differences in promotion to tenure in some disciplines, but discrimination in favour of women in engineering [14]. Bias in grant awarding has also been found, as mentioned above, in [36–39].

Given the importance that the hypotheses of time constraints and workplace discrimination have received in the literature, we concentrate on these two perspectives as prime suspects to help explain the low representation of women in higher academic ranks. Despite the rich literature on gender and academic progression, this is the largest quantitative study to have been carried out for the UK case since Blake and La Valle's in 2000 [3].

3. Data

We conducted a questionnaire amongst male and female academics, which can be found in Appendix A, and is virtually the same as that conducted by Blake and La Valle in 1999/2000 [3]. After piloting it, it went live and was open for responses from 29 May to 1 July 2013.

The sample was drawn from the 24 Russell Group universities in the UK, which were arranged in alphabetical order. The Research Excellence Framework (REF) in the UK is the system used for assessing the quality of research in UK higher education institutions. Submissions to the REF in 2013 were made in 36 units of assessment, or fields of research. Up to ten out of the 36 REF areas, which are listed in Appendix B, were randomly chosen for each of the 24 universities. The departmental websites representing the randomly selected REF areas were then used to identify all members of academic and research staff. In some cases, REF areas include more than one area, which meant a number of departments were contacted. For example, REF area 4 includes Psychology, Psychiatry and Neuroscience. If that area was randomly selected for a university, staff at all three departments were contacted if all three were represented at the institution in question. If not all departments were represented, then those that were, were the ones contacted. If an area was randomly selected for a university but had no presence at that university, another number between 1 and 36 was randomly selected. Typical cases include the London School of Economics and Political Science and Imperial College London, which are institutions with some degree of specialization where many of the 36 REF areas are missing.

A total of 13,556 names and e-mail addresses were manually collected. No scraping software of any sort was used at any point. These potential participants were then contacted by e-mail and invited to complete a survey online. Due to a number of people having left the departments in question but still being listed on their websites 886 mails were returned with a delivery failure notice. From the remaining 12,670 individuals, 2270 responded to the survey. The response rate was therefore 17.9%, but we still achieved our target of at least 2000 responses.

The response rate may have varied according to a number of reasons, and in order to correct for self-selection bias the data from the sample was weighted using post-stratification survey weights. Appendix B gives details of how weights were estimated to make our sample of 2270 respondents representative of the whole population of 62,637 individuals employed as academic and research staff at all 24 Russell Group universities in 2012, following the methodology proposed in [41,42].

4. Model

We use an ordered logit model to explore the variables that may be associated with the probability of a member of academic staff being appointed at a certain level. A member of staff's appointment is characterized as being separated into five ordered levels, which we call grade 6, grade 7, grade 8, grade 9, and grade 10, with different terms of contract (open-ended, on probation and fixed-term for grades 6, 7, and 8, and open-ended and fixed-term for grades 9 and 10). Grade 6, for example, is typically the entry level for a tenure-track academic member of staff, but it is also the level at which a postdoc on a fixed-term contract may be hired. Grade 10, at the highest end of the spectrum, is that of full professor. Most appointments at grades 9 or 10 are open-ended, although occasionally some are fixed-term. Very rarely, however, do they involve a probation period, and we only had two observations of grade 9 and two of grade 10 on probation, which we merged with those on open-ended contracts. This is not controversial because at UK universities those on probation are typically confirmed on open-ended contracts. The grading system across UK universities is fairly similar, as is the associated salary scale. Because each grade has an associated salary scale, grade and salary are virtually interchangeable at most departments and universities. The actual number given to a certain grade (6, 7, etc.) does not matter in itself as long as it is clearly defined.

In the survey we did not ask what grade respondents were appointed at, but rather, we asked for the title of their posts, so that these could be linked to a consistent grade scale which we defined as shown on Table 1.

Table 1. Grades.

Grade	Posts
6	Assistant Lecturer, Junior Lecturer, Research Assistant, Researcher, Research Fellow, Teaching Fellow
7	Researcher, Lecturer, Clinical Lecturer
8	Senior Lecturer, Senior Researcher
9	Reader, Associate Professor, Senior Researcher
10	Professor

Depending on personal preferences, an academic may prefer to be appointed at grade 9 on a fixed-term contract rather than at grade 7 on an open-ended contract, or vice versa. In other words, when grade and type of contract are combined, it is not possible to order all the possible combinations. Thus, an order can be established for:

(a) Grades 6 to 10 on probation and open-ended (i.e., excluding all fixed-term contracts);
(b) Grades 6 to 10 on fixed-term contracts (i.e., excluding all probation and open-ended contracts);
(c) Within each grade, fixed-term, probation and open-ended contracts.

Furthermore, fixed-term appointments, by definition, almost never lead to appointments at the professorial level. Thus, given that the aim of this study is to examine the association between gender and academic rank, which we also call grade, we exclude respondents on fixed-term contracts, which represent 26% of our sample, and focus on those either on probation or on open-ended contracts.

Having excluded the fixed-term contract cases, our dependent variable is grade, which ranges from grade 6 to grade 10, taking values 1 to 5 correspondingly. The type of contract can be either probation or open-ended and these two are not discriminated within this categorical variable.

We consider a number of independent variables detailed in Section 5 and use an ordered logistic model:

$$Grade^{*} = X' \times \beta + \varepsilon$$

where X is the column vector of individual characteristics and β is the column vector of coefficients to be estimated by the ordered logistic regression, with ε assumed to follow a logistic distribution.

5. Results and Discussion

All our results were computed with STATA. Tables 2 and 3 present all the variables we used and their descriptive statistics.

Table 2. Categorical variables and their descriptive statistics (unweighted sample).

Categorical Variables		Description	Frequency
Grade	1	Grade 6	50
	2	Grade 7	538
	3	Grade 8	428
	4	Grade 9	153
	5	Grade 10	477
		Missing values	624
Gender	0	Male	1210
	1	Female	1060
Marital status (defined as Dummies)		Partner (Married or Living with partner)	1736
		No partner (Separated, Widowed, Single or Other)	534
Household chores	1	Respondent does most of them	767
	2	Respondent shares them equally with someone else	1115
	3	Someone else does most of them	372
		Missing values	16
Area of research (defined as dummies)		Area 1: Science (Mathematical, Physical and Computer Sciences, Engineering, and Chemistry)	489
		Area 2: Medicine and Life Sciences (Medical Sciences, Other allied to medicine, and Life Sciences)	674
		Area 3: Social Sciences (Social Sciences, Economics and Econometrics, Law, Business and Management Studies, Architecture and the Built Environment, Education, Geography, Environmental Studies and Archaeology, Sport and Exercise Sciences, Leisure and Tourism)	626
		Area 4: Arts and Humanities (Arts and Humanities)	405
		Missing values	76
Maternity timing was influenced by promotion, tenure and/or job permanency concerns (This variable was only used to run models using two separate samples).		Yes	595
		No	936
		Not applicable	739

All the regressions we report were estimated with weights, which were computed as explained in Appendix B.

Table 3. Numerical variables and their descriptive statistics (unweighted sample).

Numerical Variables	Minimum	Maximum	Mean	Std Dev	Percentiles
Respondent's year of birth	1931	1989	1969.55	10.7198	10%: 1954 25%: 1962 50%: 1971 75%: 1978 90%: 1982
Number of children under 18	0	6	0.67797	0.02007	10%: 0 25%: 0 50%: 0 75%: 1 90%: 2
PhD	0	2	0.82026	0.3965	10%: 0 25%: 0 50%: 1 75%: 1 90%: 1
Percentage of working time spent on teaching and teaching-related activities	0	100	32.6522	24.0227	10%: 0 25%: 10 50%: 30 75%: 50 90%: 65
Journal papers (number of papers published in peer-reviewed journals in the last five years)	0	500	11.3824	22.8158	10%: 1 25%: 3 50%: 6 75%: 13 90%: 25
Conference papers (number of papers published in conference proceedings in the last five years)	0	125	4.91454	10.3027	10%: 0 25%: 0 50%: 1 75%: 5 90%: 14
Number of grants obtained in the last five years	0	6	1.5493	1.8455	10%: 0 25%: 0 50%: 1 75%: 3 90%: 5

5.1. Baseline Model

Our baseline model includes gender, year of birth, number of children under the age of 18 years, and responsibility for the household chores (cooking, shopping, cleaning, washing/ironing). As it can be seen from the column reporting the results of the baseline model in Table 4, being a woman has a negative and significant association with academic rank. This is not worrying because we are not controlling for research productivity at this stage.

We also find the usual and expected result that the younger a person is, the less likely he/she is to be high up on the academic ladder, an intuitive result in line with [12,13,17].

The number of children under the age of 18 years has a positive and significant association with grade. This result holds for the whole sample but also for the subsample of men and the subsample of women separately, although for brevity, the subsample results are not reported here. Previous research found that having children is positively associated with the academic rank of men, but found that either it has a negative association with the academic rank of women [10], or the association with the academic rank of women is not statistically significant [12,13,15].

Ours is therefore an interesting result. The problem with observational data is that it is not easy to determine causality. From an intuitive point of view, it is unlikely that having children under the age of 18 years has a positive impact on academic rank and it is more likely that academics wait to have their children until they have reached a certain grade. We further investigate this issue below.

Table 4. Ordered logistic regression of grade on alternative model specifications.

	Baseline Model	**With PhD and Research Productivity Variables**	**With PhD, Research Productivity Variables and a Teaching-Related Variable**
Gender	−0.573 ***	−0.500 ***	−0.474 ***
	(0.126)	(0.135)	(0.133)
Respondent's year of birth	−0.121 ***	−0.131 ***	−0.135 ***
	(0.008)	(0.008)	(0.008)
Number of children under 18	0.305 ***	0.216 ***	0.225 ***
	(0.063)	(0.064)	(0.065)
Household chores	0.130	0.124	0.080
	(0.097)	(0.096)	(0.096)
PhD		0.306 *	0.320 *
		(0.159)	(0.165)
Journal papers		0.020	0.016
		(0.016)	(0.015)
Conference papers		0.003	0.003
		(0.008)	(0.007)
Grants		0.276 ***	0.277 ***
		(0.045)	(0.043)
Share time on teaching			−0.018 ***
			(0.004)
Area 1 (Science) *Reference*			
Area 2 (Medicine and Life Sciences)		−0.028	−0.178
		(0.178)	(0.178)
Area 3 (Social Sciences)		0.517 ***	0.550 ***
		(0.173)	(0.173)
Area 4 (Arts and Humanities)		0.301	0.376 *
		(0.215)	(0.212)
Log pseudolikelihood	−41504.04	−39233.87	−38719.46
Number of obs	1280	1280	1280
Wald chi2	301.29	399.12	417.05
Prob > chi2	0.0000	0.0000	0.0000
Pseudo R2	0.14	0.19	0.20

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

The variable household chores has the correct sign but it is not significant. We also included a number of other variables, such as ethnicity, childcare responsibilities, and responsibility for looking after a disabled, sick or elderly friend or relative, none of which were statistically significant. On similar lines, another study finds that neither care of an elderly parent or relative nor time spent on household or childcare duties has a significant association with research productivity of faculty men or women (pp. 434–435 [30]).

We also tried marital status, but this was also non-significant, in line with (p. 400 [12]) and (p. 51 [13]). On the other hand, one study finds that having a spouse or partner employed at the same institution is unrelated to tenure and rank amongst women faculty but being married is positively associated with both tenure and rank for men faculty (p. 301 [15]), and another study finds a positive association between being married or living with a partner and salary [16].

5.2. PhD, Publications, Grants and Area of Research

Papers published in peer reviewed journals, papers published in conference proceedings, and number of grants obtained are typically seen as important for career progression in academia, and thus we included those variables in our model. We also included the variable PhD (no PhD degree, one PhD degree, two PhD degrees). In addition, we included research area in order to control for differences across different fields of knowledge. The results are reported on Table 4, under the column entitled PhD and research productivity variables. As in the baseline model, gender has a negative coefficient and is statistically significant. Given that we are controlling for research productivity, this result is very worrying and may be an indicator of discrimination against women. Being a woman per se has a negative association with grade. This is in line with findings in [10–13,15,17,19,40]. On similar lines, a study on faculty salaries, finds a negative association between being a woman and salary (p. 595 [16]).

The variables year of birth and number of children under 18 have the same sign as before and are significant. Again, the variable household chores is not significant.

Having a PhD, as expected, has a positive association with grade, although the variable is only significant at 10% in this specification. Another intuitive result, similar to that found in [18], is the positive association between the number of grants obtained in the last five years and academic rank. The reason that neither the number of papers published in peer-reviewed journals nor the number of papers published in conference proceedings in the last five years is statistically significant, even though both coefficients have the expected positive sign, is that these two variables are correlated between themselves and with the number of grants, as could have been reasonably expected. Importantly, all three variables are significant at least at a 5% level when they are included alone in the model. Another study finds that the number of publications is important for academic progression, but grants obtained are not [20], probably due to the two variables being correlated, although it does not consider this as a possible explanation for this counterintuitive result.

The reference (research) area in this and all specifications in this study is area 1 (Science). This is an arbitrary choice as any area could have been used as reference area.

The results show that for the models on Table 4 that take into account research area, relative to area 1 (Science), there are no significant differences, except for area 3 (Social Sciences), i.e., academics working in Social Sciences are likely to hold a higher rank, everything else being equal.

We also tried models which included marital status and ethnicity but none of these variables proved to be statistically significant.

In addition, we estimated a number of OLS regressions with journal publications, conference proceedings, and grants as dependent variables, and gender, area, grade, and number of children under 18 as independent variables. The results are presented in Table A6 of Appendix C. The coefficient for gender was negative and significant, albeit at 10%, for journal publications, i.e., women publish less, in line with [14,17,21–27]. For conference proceedings and for grants, the coefficient for gender was not significant. The coefficient for grade was positive and significant in all three regressions. A higher grade may "provide the level of resources and job security that serve to bolster one's level of productivity" (p. 436 [30]) or academics with higher grades may be simply more experienced and therefore more productive. The coefficient for the number of children under the age of 18 years was not significant in the journal publications or the conference proceedings regressions, in line with [27,29–31]. One study finds a positive relationship between having children and journal publications for female economists but no relationship for male economists [32]. Our coefficient for the number of children under 18, however, remained not significant even when we ran separate regressions for men and for women, although for brevity, these are not reported. The coefficient for the number of children under 18 was positive and significant in the grants regression.

5.3. Percentage of Time Spent on Teaching and Teaching-Related Activities

The percentage of working time allocated to different activities during the working day can have an impact on academic rank. Thus, we specified a model which includes the percentage of time spent

on teaching and teaching-related activities, as reported by respondents. The last column of Table 4 shows the results. Gender, year of birth, and number of children all have the same signs as before and are statistically significant. The variable household chores continues to be not significant and having a PhD has the same sign as before and continues to be significant at a 10% level. The variables on research productivity have the same signs and significance as before. For the area of research, relative to area 1 (Science), there are positive differences for area 3 (Social Sciences), at a 1% level, and for area 4 (Arts and Humanities), at a 10% level, i.e., academics working in Social Sciences or in Arts and Humanities are likely to hold a higher rank than academics working in Science, with everything else constant.

The coefficient for percentage of time spent on teaching and teaching-related activities is negative and statistically significant, in line with [18]. On similar lines, another study finds that "involvement in teaching negatively affects salary" (p. 886 [43]). Either teaching does not help career progression or those in lower academic ranks are given a heavier teaching workload, or both, potentially making this a vicious circle.

We also estimated the OLS regressions of Table A6 again, adding the percentage of time spent on teaching and teaching related activities as an independent variable. The results are reported in Table A7 of Appendix C. The coefficient for gender ceased to be significant in the journal publications regression, remained not significant in the conference proceedings regression, and was positive and significant, albeit at 10%, in the number of grants regression. This is a key result because it reveals that once we control for the share of time spent on teaching, women publish as many journal papers as men and get more grants than men.

The coefficient for grade continued to be positive and significant in all three regressions. The coefficient for the number of children under the age of 18 years continued to be not significant in the journal publications and in the conference proceedings regressions, and positive and significant in the grants regression.

Crucially, the coefficient for percentage of time spent on teaching and teaching related activities was negative and significant at a 1% level in the journal publications regression. It was also negative and significant, albeit at a 10% level, in the conference proceedings and grants regressions. Although we cannot establish causality this is a very important result.

In order to understand whether the percentage of time spent on teaching affects the academic rank of women and men differently, we estimated the same model for men only and for women only, but this time we dropped the variable household chores, which was consistently not significant in Table 4. Table 5 shows the results. The variables year of birth and number of grants have the same sign as before and are significant. Number of children under 18 also has the same sign as before and is significant, but only at a 5% level for women. The coefficients for journal and conference publications continue to be positive and not significant, except for journal publications in the case of women, which is now significant. PhD is not significant any longer in the case of women. For areas of research, relative to area 1 (Science), there are no significant differences, except for area 3 (Social Sciences) in the case of men. Percentage of time spent on teaching and teaching-related activities is still negative and statistically significant in both cases but with a slightly lower coefficient for men.

In order to understand how correlated teaching is to gender, as well as to area of research and academic rank we estimated an OLS regression. Table 6 shows the results.

As it can be seen on Table 6, the coefficient for area 2 (Medicine and Life Sciences) is negative and significant and the coefficients for area 3 (Social Sciences) and 4 (Arts and Humanities) are positive and significant, implying that the percentage of time spent by faculty on teaching is lower in Medicine and Life Sciences relative to Sciences, and higher in Social Sciences and Arts and Humanities, relative to Science. Although counterintuitive at first sight, many teaching contact-hours in courses falling under the remit of Medicine, Life Sciences, and Science tend to rely on lab and class work, usually led by teaching assistants, demonstrators, and PhD students, who are on casual and fixed-term contracts,

rather than on faculty. Faculty in the Arts and Humanities and in the Social Sciences, on the other hand, tend to bear most of the contact-hours with students, and hence the difference in coefficients.

Table 5. Ordered logistic regression of grade for men and women subsamples.

	Men Only	**Women Only**
Respondent's year of birth	−0.146 ***	−0.114 ***
	(0.010)	(0.012)
Number of children under 18	0.267 ***	0.198 **
	(0.084)	(0.094)
PhD	0.510 **	0.049
	(0.223)	(0.244)
Journal papers	0.010	0.043 ***
	(0.013)	(0.010)
Conference papers	0.001	0.007
	(0.008)	(0.017)
Grants	0.301 ***	0.250 ***
	(0.054)	(0.050)
Share time on teaching	−0.016 ***	−0.019 ***
	(0.005)	(0.004)
Area 1 (Science) *Reference*		
Area 2 (Medicine and Life Sciences)	−0.200	−0.290
	(0.216)	(0.295)
Area 3 (Social Sciences)	0.752 ***	0.264
	(0.215)	(0.294)
Area 4 (Arts and Humanities)	0.302	0.435
	(0.259)	(0.342)
Log pseudolikelihood	−25619.11	−12969.67
Number of obs	730	556
Wald chi2	241.30	182.72
Prob > chi2	0.0000	0.0000
Pseudo R2	0.20	0.18

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

Importantly, the coefficient for gender is positive and significant. According to these results, the women in our sample tend to spend a higher percentage of their working time on teaching and teaching-related activities than their male counterparts. This result is in line with findings in [25,27,44].

We also find that the lower the academic rank, the higher the percentage of time spent on teaching. Since women tend to have lower academic ranks than men, the two effects may have some synergy and become an obstacle for academic progression. With that in mind, we present the results of a second regression, where a statistical interaction term, gender × grade, is also included as an explanatory variable. The coefficient of the interaction term is the difference in the effect of grade between men and women. The fact that the interaction is significant, albeit at a 5% level, indicates that the effect of grade is different for men and for women. It should be noted, however, that the variable grade is now not statistically significant, which is not a problem because adding an interaction term drastically changes the interpretation of all the coefficients, i.e., the effect of grade is now conditional on the value of gender (and vice-versa). The effect of grade is now −0.896 for men and −3.061 for women. This is obtained as $-0.896 - 2.165 \times 0 = -0.896$ and $-0.896 - 2.165 \times 1 = -3.061$, respectively. Put more simply, going up one grade (say from lecturer to senior lecturer or from senior lecturer to reader) reduces the percentage of time spent on teaching by a factor of 0.896 for men and by a factor of 3.061 for women. Women going up the academic ladder see the percentage of time they spend on teaching and teaching-related activities decrease more than men going up the academic ladder, everything else being equal.

Table 6. Linear regression of percentage of time spent on teaching and teaching-related activities on gender, area of research, grade, and gender × grade.

	Without Interaction Term	**With Interaction Term**
Gender	3.408 ***	9.799 ***
	(1.271)	(3.311)
Area 1 (Science) *Reference*		
Area 2 (Medicine and Life Sciences)	−7.962 ***	−7.938 ***
	(1.643)	(1.644)
Area 3 (Social Sciences)	3.864 ***	3.776 ***
	(1.450)	(1.450)
Area 4 (Arts and Humanities)	8.712 ***	8.668 ***
	(1.563)	(1.560)
Grade	−3.680 ***	−0.896
	(.484)	(1.407)
Gender × Grade		−2.165 **
		(0.928)
Constant	44.634 ***	36.200 ***
	(2.698)	(5.214)
Number of obs	1597	1597
F	F (5, 1591) = 48.71	F (6, 1590) = 45.22
Prob > F	0.0000	0.0000
R-squared	0.1469	0.1499
Root MSE	19.416	19.389

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

The effect of gender is now 9.799 − 2.165 × grade, with grade taking values between 1 and 5. It is easy to check that this effect decreases as grade increases, and becomes negative for the highest grade, 5, which is that of professor.

To summarize, the results from the second regression on Table 6 indicate that, for any given research area, 1, 2, 3 or 4, the percentage of working time spent on teaching and teaching-related activities is higher for women than for men at all grades, except for that of professor, when it is finally slightly lower, thanks to the more rapid decrease they experience, relative to men, as they progress on the academic ladder.

A higher percentage of working time spent on teaching and teaching-related activities may be an indicator of a heavier teaching load. Since we did not ask any question about the total number of hours effectively worked per year (rather than contracted), we cannot discard the possibility that men and/or those in higher academic ranks work many more hours than women and/or those in lower academic ranks, in which case the percentage of working time spent on teaching and teaching-related activities could potentially be lower even if the actual teaching load (measured for example by contact hours and number of students) were the same or higher.

Heavier teaching loads on women could be the result of subtle, probably unintentional, discrimination, which arguably, becomes less obvious as women progress academically and the percentage of time they spend on teaching and teaching-related activities decreases more than that of their male counterparts, for each grade they progress.

5.4. Timing of Children

The most puzzling result in this study is that the variable number of children under the age of 18 years has a positive association with the academic rank for both men and women, and not just for men, as previously found in [10,12–15]. Our results are more in line with [11], which finds that although young children (under the age of 6 years) reduce the chances of women getting a tenure-track job, older children (aged 6 to 17 years) have a positive association with women getting a tenure-track job and with both men and women getting tenure. Interestingly, in contrast with us, the authors find no effect of children, young or old, on men or women being promoted to full professor [11]. They argue

that the need to provide for their children motivates academics to get tenure-track jobs and tenure, but once tenure is secured there is no motivation to get a full professorship on economic grounds as they have already ensured that their children will be provided for [11].

The answer to the puzzle of this positive association between the number of children under the age of 18 years and academic rank in our results seems to be linked to the timing of children. One of the questions in the survey asked if the respondent's timing with regard to having a child had been influenced by promotion/tenure/job permanency concerns. Therefore, we estimated two regressions, one for those whose timing was influenced by career concerns and one for those whose timing was not. Table 7 shows the results.

Table 7. Ordered logistic regression of grade for those who timed their children with career considerations in mind and those who did not.

	Subsample that Timed Children with Career Considerations	**Subsample that Did not Time Children with Career Considerations**
Gender	−0.305	−0.733 ***
	(0.282)	(0.182)
Respondent's year of birth	−0.213 ***	−0.127 ***
	(0.022)	(0.012)
Number of children under 18	0.457 ***	0.100
	(0.149)	(0.089)
PhD	0.054	0.204
	(0.358)	(0.228)
Journal papers	0.046 ***	0.015
	(0.009)	(0.021)
Conference papers	−0.026 *	0.002
	(0.015)	(0.011)
Grants	0.425 ***	0.161 ***
	(0.075)	(0.058)
Share time on teaching	−0.010	−0.022 ***
	(0.009)	(0.005)
Area 1 (Science) *Reference*		
Area 2 (Medicine and Life Sciences)	0.462	−0.436 *
	(0.371)	(0.253)
Area 3 (Social Sciences)	1.113 ***	0.399 *
	(0.380)	(0.234)
Area 4 (Arts and Humanities)	1.497 ***	0.057
	(0.450)	(0.301)
Log pseudolikelihood	−6911.27	−19625.55
Number of obs	307	617
Wald chi2	166.26	164.60
Prob > chi2	0.0000	0.000
Pseudo R2	0.34	0.16

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

The coefficient for year of birth in Table 7 continues to be negative and significant. Having a PhD is not significant any longer. Journal and conference publications have the expected sign and are now significant for the subsample of respondents who timed their children with career considerations but are still not significant for the subsample of those who did not. The coefficient for number of grants continues to be positive and significant. The percentage of time spent on teaching and teaching-related activities continues to be negative but is now not significant for the subsample of respondents who timed their children with career considerations.

For the subsample of respondents who timed parenthood, the results for area of research are as follows. Relative to area 1 (Science), there are positive differences for area 3 (Social Sciences) and for area 4 (Arts and Humanities), both at a 1% level. For the subsample of respondents who did not time

parenthood, relative to area 1 (Science), there are negative differences for area 2 (Medicine and Life Sciences) and positive differences for area 3 (Social Sciences), albeit both only significant at a 10% level.

Moving on to the variables gender and number of children under 18, both of which have been consistently significant in all our models, Table 7 shows what could be regarded as the most important finding in this study. The coefficient for the variable number of children under the age of 18 years, which was positive in all our previous regressions, remains positive and significant when only those whose timing was influenced by career considerations are included in the sample. However, when only those whose timing was not influenced are included in the sample, the coefficient for the variable number of children under 18 becomes not significant. Another interesting result is that the coefficient for gender, which was consistently negative and significant in all our models, becomes not significant for those who timed their babies with career considerations, and we discuss this further below.

A caveat that needs to be highlighted is that the samples are rather small in both cases because: (a) 54% of all those on open-ended contracts and 71% of those on probation did not have children under the age of 18 years at the time of the survey, (b) the already small group of respondents who did have children under the age of 18 years was split into those who timed and those who did not time parenthood with career considerations, and (c) the sample of those who timed their children would have been 27% larger and the sample of those who did not time their children would have been 22% larger if all respondents with children under the age of 18 years had disclosed their age. Dropping the variable year of birth would make the samples larger but an important control variable, significant in all our models, would be lost in that case.

The association between number of children under the age of 18 years and higher grade does not equal causality. Given that the variable number of children under 18 is significant for the sample who timed their children with career considerations in mind but not significant for the sample who did not, there would appear to be some evidence to suspect that rather than children having a positive impact, children arrived after a certain grade had been secured.

The fact that the variable gender, which was negative and significant in all our models, becomes not significant for the sample who timed their babies, could also be seen as evidence that women who timed their children secured a certain grade first, thus protecting themselves from discrimination, or at least discrimination after having children.

Timing seems to be key. This important finding implies that women may find the decision of when to have a baby excruciating because postponing motherhood could cost them not ever having children at all, as fertility declines with age. There is evidence that "women are more successful in obtaining academic careers if they delay or forsake marriage and children" (p. 401 [11]) and that academics who did not have children often regret the decision later in life when it is too late, as do those who wish they had had more children (p. 69 [10]). A qualitative study also finds that "women academics have been tailoring their personal lives to fit their professional lives" (p. 223 [45]).

The fact that men and women may need to time their reproduction per se reflects that academia is not women friendly. Furthermore, it is worth highlighting that although 50% of our (unweighted) sample of respondents were of childbearing age (42 years old or younger) at the time of the survey (i.e., 2013), 60.7% did not have any children under the age of 18 years. In England and Wales, about 20% of women are childless at the age of 45 years [46], compared to 53% in our sample. Furthermore, 15.9% reported that their decision on whether to have or not to have children had been based on career considerations, and 57% from those whose decision on whether to have children or not had been based on career considerations did not have children of any age.

For comparison purposes, 66% of the surveyed academic women in [3] did not have children under the age of 18 years even though 80% of them were 50 years old or younger, 53% of academic women in the sample in [27] did not have any children, and 42% of academic women with tenure in the sample in [10] did not have any children. In our sample 48% of women on open-ended contracts did not have children of any age.

Figure 1 shows the percentage of respondents in our sample who did not have children of any age at the time of the survey by gender and type of contract.

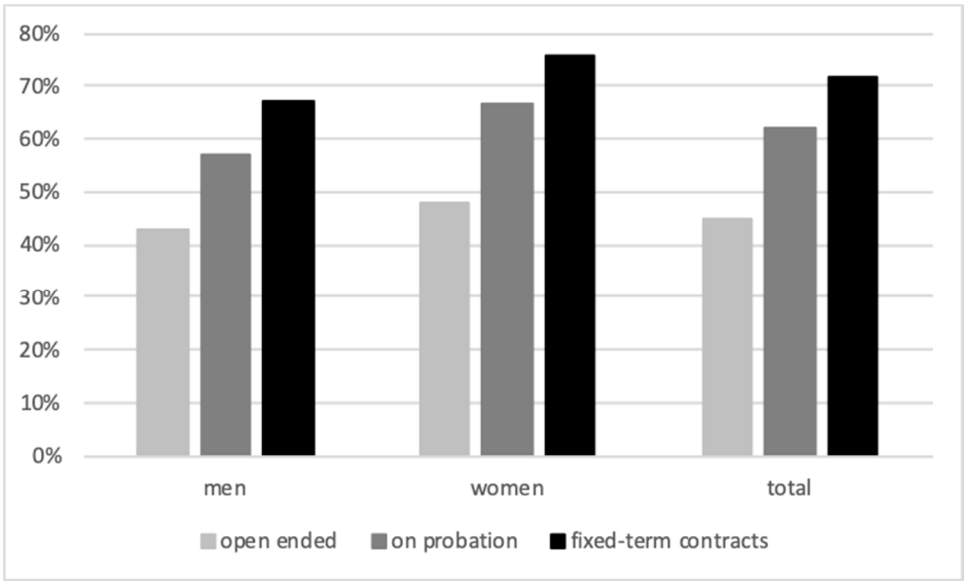

Figure 1. Percentage of respondents who do not have any children by gender and type of contract. Source: Unweighted survey responses.

Figure 1 supports our finding about timing of children with career considerations, and is in line with [45], who finds that academic women tend to time having babies for after they have secured permanency. In our sample, this conclusion also applies to men. However, for every type of contract, the percentage of men who do not have any children is lower than the percentage of women who do not have any children. For the whole sample the difference (50% versus 59%) is statistically significant at 1%.

Figure 1 also shows that the percentage of respondents that do not have any children decreases as the terms of their employment become more secure. This can be explained by two logical, intuitive reasons. One reason could be simply responsible parenthood, which concerns the consideration of the factors that have a bearing on whether to start a family and also, on family size. Potential parents may decide that in order to provide for the basic and also other needs of their children they would rather have a permanent job, or at least, be on the track to one. Another reason could be simply that the average age of all respondents on open-ended contracts at the time of the survey was 48 years, and so most of those respondents wanting to have children would have already had them. This age-related explanation, however, does not seem to apply fully to our sample because the average age of those on probation was 35 years, three years younger than the average age of those on fixed contracts. Despite those on fixed contracts being older, on average, than those on probation, the percentage of those with no children was higher.

Despite the caveat of "responsible parenthood" the statistics from Figure 1 are somewhat worrying and tell a story of the kind of working environment that academia is, or at least is perceived to be. This is surprising given that all universities have written policies on work-life balance, which at least on paper, support family life. Clearly, perceptions need to be changed, so that structural change can be brought about. We discuss some policy recommendations regarding this issue in the last section.

5.5. Other Variables

It is worth noting that we estimated many alternative specifications of the model, including a number of other variables. For example, as well as papers in peer-reviewed journals and papers in conference proceedings included in some of our tables, we also tried guest-edited journal volumes,

chapters in books, authored books, and edited books. None of these variables was significant. We also tried variables on availability of flexible working arrangements, part-time opportunities, good career guidance, influential role models and/or mentors, support from senior colleagues, support from other colleagues, knowing the "right people" within the respondent's institution and/or outside, availability of good childcare, and support from partner/spouse. In addition, we tried variables on academic activities which respondents had to reduce involvement in and/or attendance to because they were pregnant/expecting a child and/or had preschool age children, such as committees/boards memberships, refereeing and peer reviewing, guest-editing journal volumes, being main editor of a journal, being on Editorial Boards of academic journals, invitations to present keynote speeches, lectures or chair sessions at conferences, presenting other papers at conferences, amongst others.

The variables that consistently proved to be significant in our regressions were gender, number of children under 18, percentage of time spent on teaching and teaching-related activities, and number of grants obtained.

6. Policy Recommendations

The 24 Russell Group universities have a number of policies in place already to support work-life balance and family life, including flexible working arrangements and part-time opportunities. In the UK, all employers also offer unpaid parental leave schemes to care for children under the age of 18 years. In addition, the biological father or the mother's partner (regardless of gender or marital status) is typically entitled to one or two weeks of paternity leave following the birth or adoption of a child, with at least statutory pay, and in some cases, full pay. Most Russell Group universities also offer generous maternity leave packages, with new mothers being entitled to up to 52 weeks of maternity/adoption leave, with at least the first 18 weeks being paid at 90% of their salary. Some universities have even more generous packages. In 2015, the UK government also introduced shared parental leave, which allows parents to share up to 50 weeks of leave and 37 weeks of statutory pay after their child is born. All 24 universities offer this. The uptake of shared parental leave in the UK has been low mainly due to workplace culture as well as parents' views, which see the mother as the primary caregiver, especially in the first year, and the complexity of the shared parental leave policy [47]. Another factor for the low uptake may also be financial, as in many cases the combined income is lower with shared parental leave than with the traditional maternity leave.

Many of the Russell Group universities offer subsidized childcare within campus, others offer subsidies for childcare off campus, and the UK government also offers tax-free childcare, albeit with a cap. In addition, most universities offer career guidance through appraisal schemes for men and women, and in some cases, through workshops designed by and for women specifically. As explained in Section 5.4, we tested all of these variables but they were not statistically significant, which does not necessarily imply that these policies and benefits are not important. If they were not in place, the gender gap would probably be wider. Despite all these policies and benefits, our results show that women tend to hold lower grades than men. In order to achieve structural change at the institutional level and facilitate the advancement of women in academia, we propose the following two policies, following up from the variables that were found to have an association with academic rank: transparent workload models and promotion on the basis of clear and transparent criteria.

Universities should have systems in place to allow a fair and equitable distribution of teaching (and administrative) loads amongst faculty as well as continuous monitoring of such distribution. This could be actioned through, for example, a transparent workload model where everyone can see everybody else's teaching loads, including number of courses taught, contact hours, number of students, marking, dissertation supervision, etc. Some British universities, including some in the Russell Group, have already adopted or are in the process of adopting workload models. Some are university-wide workload models and others are designed within Schools or Departments. The tariffs used vary across institutions, and sometimes, across Schools or Departments within the same institution, and are at present the subject of much debate. The tariffs of any workload model meant

for academics should be set by academics, as academics know the time it takes to prepare a lecture, mark an exam, supervise a student project, write a journal paper, prepare a research proposal, etc. In addition, promotion should be based on clear and transparent criteria. Although there are typically three criteria by which candidates for promotion are judged (research, teaching, and administration), these criteria are not equally weighted (p. 2 [7]), (p. 47 [22]). The decisive factor for promotion is research, i.e., if a candidate's research is deemed inadequate, no amount of teaching or administration will compensate for this (p. 48 [22]). If this is the path that the Russell Group Universities want to stick to then this should be made crystal clear and no claims of the possibility of promotion on the basis of teaching (or administration) excellence should be made. Guidelines should be communicated to all staff so that everyone is clear that the most important criterion for promotion is research. However, if universities are going to continue with their current (written) policies for promotion, many of which include excellence in teaching, then, these policies should be implemented in practice. Excellence in teaching, however, is difficult to demonstrate. Student evaluation, for example, could be one of the metrics, although this is frequently positively correlated with faculty evaluation (higher grades on average) of students and small class sizes [22]. Peer and other evaluations may also be controversial, so careful thought would need to be given to how excellence in teaching can be established.

Adopting these two policies will help reduce the discriminatory teaching loads on women, which is a contributor to their lack of progression, and will make promotions fairer and more transparent, with a probable outcome of having more women climbing up the academic ladder.

7. Conclusions

Using an ordered logit model and the results of a survey, which we conducted in 2013, with 2270 observations of academics of both genders at all levels in all fields of knowledge at the 24 Russell Group universities in the UK, we have examined the association between gender and academic rank, controlling for a number of variables, including but not limited to, respondent's year of birth, number of children, responsibility for household chores, academic degrees, number of publications, grants, percentage of working time spent on teaching and teaching-related activities, and main area of research.

One caveat that should be highlighted is that this study only finds associations with models that use observational data. Causal relationships cannot be identified with the current dataset. Still, the associations found are very important and can guide policy.

Our findings can be summarized as follows.

A negative association between being a woman and academic rank is indeed observed in all our models but one, when run for a small subsample of male and female academics who timed their children with career considerations in mind. In general, however, women are less likely to hold a higher academic rank even after controlling for individual characteristics using variables like respondent's year of birth, marital status, responsibility for the household chores, area of research, number of children under 18, holding a PhD or not, percentage of working time spent on teaching and teaching-related activities, and a number of research productivity variables. This result is in line with [10–15,17,19,40], all of whom also find that women tend to progress at a lower rate than men, even after accounting for variables that would capture family formation and/or academic/research achievements. We call this the gender effect. Put simply, two people who have similar, or even identical credentials and personal circumstances except for one being a man and the other being a woman, are likely to have different academic ranks, with the man having a higher rank than the woman. One explanation for this phenomenon may be discrimination against women.

Another important finding is that the percentage of time spent on teaching and teaching-related activities has a negative and statistically significant association with academic rank, in line with [18]. On similar lines, another study finds a negative association between teaching and salary [43]. Furthermore, our results show that women spend a higher percentage of their working time on teaching and teaching-related activities than men at all academic grades, except for that of professor. This is in line with [25,27,44], which also find that women tend to spend either more time or a higher

percentage of their working time on teaching and teaching-related activities, but in contrast with [3,7], which do not find differences between the genders related to absolute or relative time spent on teaching and teaching-related activities.

In addition, we find that going up one grade (say from lecturer to senior lecturer or from senior lecturer to reader) reduces the percentage of time spent on teaching more for women than for men, and so eventually, female professors spend a lower percentage of their working time on teaching and teaching-related activities than male professors.

If a higher percentage of working time spent on teaching and teaching-related activities is to be taken as an indicator of a heavier teaching load, then we can conclude that women at all ranks, except for that of professor, are being discriminated against. At the same time, relative to men, women experience a higher reduction in the percentage of time spent on teaching and teaching-related activities by going up one grade.

Another important result, which is new and has not been quantified before for the UK, is a positive and significant association between number of children under the age of 18 years and the academic rank of both men and women, as long as babies were timed with career considerations in mind. In line with [11], the reason for this is very unlikely to be that children have a positive impact on academic rank, other than triggering their parents' eagerness to achieve a certain level of job stability and income in order to provide for them. What this result is probably showing is that children arrived after a certain rank (for example, an open-ended contract) had been secured. Importantly, for the subsample of academics who timed their children, the variable gender ceases to be significant.

These findings pose a dilemma for women because the 30 s is the decade when they have two competing goals in their lives: establishing themselves in their careers having finished their doctorates, and having children. Delaying pregnancy can mean that these women are left childless as fertility declines with age, especially after the age of 35 years. Some further inspection of our data confirms our finding about timing of children with career considerations: the percentage of respondents that do not have children (of any age) decreases as the terms of their employment become more secure. This state of affairs is especially biased against women.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

In this Appendix we include the survey that was conducted in 2013, which provided the data for this study.

Survey: Gender and Academic Progression

WELCOME

My name is Georgina Santos and I am a lecturer at Cardiff University.

I am undertaking a piece of research to assess and understand whether there are any problems linked to Gender and Academic Progression. In 2010/11 44.2% of all the academic staff employed at UK Higher Education Institutions were female, yet only 19.8% of Professors were women (Higher Education Statistics Agency, 2012).

I would be very grateful if you could complete this questionnaire, which is essentially the same questionnaire that was conducted in 1999–2000 by the National Centre for Social Research (Blake, M. and I. La Valle, 2000, "Who applies for research funding", report published by the Wellcome Trust), although the aims and objectives of that piece of research were different from mine.

Higher Education Statistics Agency (2012), Staff at higher education institutions in the United Kingdom 2010/11. https://www.hesa.ac.uk/news/19-01-2012/sfr170-staff.

Blake, M. and I. La Valle (2000), Who Applies for Research Funding? Key factors shaping funding application behaviour among women and men in British higher education institutions, An independent summary report prepared for the Biotechnology and Biological Sciences Research Council (BBSRC), the Economic and Social Research Council (ESRC), the Engineering and Physical Sciences Research Council (EPSRC), the Medical Research Council (MRC), the Natural Environment Research Council (NERC), the Particle and Physics Research Council (PPARC) and The Wellcome Trust, London: The Wellcome Trust. https://wellcome.ac.uk/sites/default/files/wtd003209_0.pdf.

DATA PROTECTION

For the purposes of this survey Cardiff University is the data controller. All data collected in this survey will be held securely by the survey software provider (University of Bristol) under contract and then retained by the research team working on the project "Gender and Academic Progression" at Cardiff University in accordance with the Data Protection Act (1998). Data from the survey, including answers to questions where personal details are requested, will only be used by the research team for research purposes and will not be shared with anyone outside the research team.

Participation in the survey is completely voluntary and you may withdraw at any point. You may also complete part of it and save it to complete it later.

Cookies, personal data stored by your Web browser, are not used in this survey.

Background & Demographic Information

1. What is your gender?
   Male
   Female

2. What is your date of birth?
   DD-MM-YYYY (Optional)

3. What is your marital status?
   Married
   Living with a partner
   Separated
   Widowed
   Single
   Other

a. What is your partner/spouse's main activity? *Please tick one only. (for married)*
   Working full-time (30 or more hours per week)
   Working part-time (less than 30 hours per week)
   Unemployed and looking for work
   Looking after the home and family
   In full-time education
   Permanently sick or disabled
   Retired
   Other

b. What is your partner/spouse's main activity? *Please tick one only*. (for living with partner)
Working full-time (30 or more hours per week)
Working part-time (less than 30 hours per week)
Unemployed and looking for work
Looking after the home and family
In full-time education
Permanently sick or disabled
Retired
Other

c. In what year did you get married?
… … … … … … … … … …

4. Do you have any children aged 18 years or younger (including adopted and fostered children)?
Yes
No

a. Please, state number of children (including adopted and fostered children) and their ages.

b. In your family, who is mainly responsible for childcare (excluding any paid childcare you may have)? *Please tick one only.*
Myself
My partner/spouse
Someone else
Myself and partner/spouse equally
Myself and someone else equally
Partner/spouse and someone else equally

5. If you don't have children aged 18 years or under, please tick 'Not applicable' on all the options in the following table.
If you have children aged 18 years or under, please tick Yes, No or Not applicable.
Which of the following have you used while in your current job? *Please tick one column in each row.*

	Used in my Current Job:		
	Yes	**No**	**Not Applicable**
a. Term-time contract			
b. Paid leave when child(ren) are ill			
c. Unpaid leave when child(ren) are ill			
d. Maternity leave longer than statutory (14 weeks)			
e. Paid paternity leave			
f. Unpaid paternity leave			
g. Career breaks for domestic/family reasons			
h. A workplace based crèche			
i. Employer pays some or all childcare costs			
j. Employer is with a childcare vouchers scheme (max. £243 per month)			
k. Employer offers additional tax breaks on childcare costs on top of the £243 per month offered by the government			
l. Working from home			

6. Do you have responsibility for looking after a disabled, sick or elderly friend or relative? *(Optional)*
Yes
No
Partially

7. Who does the household chores (i.e.: cooking, shopping, cleaning, washing/ironing) in your family? *Please tick one only. (Optional)*
   I do most of them
   My partner/spouse does most of them
   Someone else does most of them
   I share them equally with my partner/spouse or someone else

8. Which of the following groups best describes your ethnic origin? *Please tick one only. (Optional)*
   White
   Black-Caribbean
   Black-African
   Black-Other
   Indian
   Pakistani
   Bangladeshi
   Chinese
   Other

Please note that the following questions apply whether you are a man or a woman.

9. Please select the options(s) that best describe your situation(s). *(Select all that apply)*
   Are or were expecting a child before earning tenure/getting an open-ended contract/being confirmed on post until retiring age.
   Have or had pre-school age children to care for before earning tenure/getting an open-ended contract/being confirmed on post until retiring age.
   Are or were expecting a child after earning tenure/getting an open-ended contract/being confirmed on post until retiring age but prior to promotion to full professor.
   Have or had pre-school age children to care for after earning tenure/getting an open-ended contract/being confirmed on post until retiring age but prior to promotion to full professor.
   None of the above

10. Please tick one box in each row.

	Academic activities which you had to reduce involvement in/attendance to because you were pregnant/expecting a child and/or had pre-school age children.				
	Yes, considerably	**Yes, moderately**	**Yes, slightly**	**No**	**Not applicable**
a. Membership of external research & professional committees/boards (e.g.: research council selection boards or committees, committees of professional societies)					
b. Refereeing and peer reviewing (e.g.: peer reviewing applicants for Research Councils, peer reviewing articles for journals & conference papers)					
c. Guest-editing journal volumes					

d. Being main editor of a journal (Editor-in-Chief, Associate Editor, etc.)					
e. Being on Editorial Boards of academic journals					
f. Invitations to present keynote speeches, lectures or chair sessions at conferences					
g. Presenting other papers at conferences					
h. Attending conferences without presenting papers					
i. External examiner at other HE institutions					
j. Assessor for RAE or REF					
k. Assessor for Teaching Quality Assessment					
l. Technology transfer/liaison with industry/industrial secondment					
m. Joint research/consultancy with other organisations (e.g.: government, charities)					
n. Visiting/exchange with other HE institutions (for a term or longer)					

Note: RAE: Research Assessment Exercise, REF: Research Excellence Framework.

11. Is or was your decision on whether to have children influenced by promotion/tenure/job permanency concerns?
    Yes
    No
    Not applicable

12. Is or was your timing regarding having children influenced by promotion/tenure/job permanency concerns?
    Yes
    No
    Not applicable

13. What is your grade of employment? *Please tick one only.*
    Professor/Head of Department
    Reader
    Principal lecturer/Senior lecturer
    Clinical lecturer
    University lecturer
    Assistant lecturer
    Departmental lecturer
    Senior Researcher
    Researcher
    Research assistant
    Teaching fellow
    Senior teaching fellow

Other (please specify):
Please state the precise year when you obtained the previously reported grade:

14. Are you a member of the University and College Union? *(Optional)*
Yes
No

15. Are you on an open-ended contract (i.e., appointed to the retiring age), on probation (on track to an open-ended contract) or on a fixed term contract? *Please tick one only.*
Open-ended contract (i.e., appointed to the retiring age)
On probation (on track to an open-ended contract)
Fixed term contract

16. Is your contract full-time (30 h a week or more) or part-time (less than 30 h a week)? (Please include job share as part-time) *Please tick one only.*
Full-time (throughout the year)
Full-time (term-time only)
Part-time (throughout the year)
Part-time (term-time only)

17. What have been your main areas of research in the last five years (i.e.: since January 2008)? Please code up to three subjects, the one on which you have spent the most time first, using the list of subject codes provided below. Note that this question refers to your own areas of research, not the main research area of the department in which you are based. If you have not conducted research at all in the last 5 years please put NA.

	CODE ***(please use the list of subject codes provided below)***
a. Most important area of research in last 5 years:	
b. Second most important area of research in last 5 years:	
c. Third most important area of research in last 5 years:	

Units of Assessment **The REF has 36 units of assessment, as follows:**		
Main Panel	**Unit of Assessment**	
A	1	Clinical Medicine
	2	Public Health, Health Services and Primary Care
	3	Allied Health Professions, Dentistry, Nursing and Pharmacy
	4	Psychology, Psychiatry and Neuroscience
	5	Biological Sciences
	6	Agriculture, Veterinary and Food Science
B	7	Earth Systems and Environmental Sciences
	8	Chemistry
	9	Physics
	10	Mathematical Sciences
	11	Computer Science and Informatics
	12	Aeronautical, Mechanical, Chemical and Manufacturing Engineering
	13	Electrical and Electronic Engineering, Metallurgy and Materials
	14	Civil and Construction Engineering
	15	General Engineering

C	16	Architecture, Built Environment and Planning
	17	Geography, Environmental Studies and Archaeology
	18	Economics and Econometrics
	19	Business and Management Studies
	20	Law
	21	Politics and International Studies
	22	Social Work and Social Policy
	23	Sociology
	24	Anthropology and Development Studies
	25	Education
	26	Sport and Exercise Sciences, Leisure and Tourism
D	27	Area Studies
	28	Modern Languages and Linguistics
	29	English Language and Literature
	30	History
	31	Classics
	32	Philosophy
	33	Theology and Religious Studies
	34	Art and Design: History, Practice and Theory
	35	Music, Drama, Dance and Performing Arts
	36	Communication, Cultural and Media Studies, Library and Information Management

Current employment conditions and workload

If you have more than one job, please answer the questions in this section for the academic/research job on which you spend most time. If you spend equal time on two jobs, answer for the one which you have held for longest.

18. Which of the following are available in your current job (whether formally or informally)? *Tick yes, if they would be available to you if you had children or you were expecting a child. We would like to hear from all respondents, even if the benefits are not applicable to you or you don't know if they are available. Please tick one column in each row.*

	Available in your current job whether formally or informally		
	Yes, available	**No, not available**	**I don't know**
a. Term-time contract			
b. Paid leave when child(ren) are ill			
c. Unpaid leave when child(ren) are ill			
d. Maternity leave longer than statutory (14 weeks)			
e. Paid paternity leave			
f. Unpaid paternity leave			
g. Career breaks for domestic/family reasons			
h. A workplace-based crèche			
i. Employer pays some or all childcare costs			
j. Employer is with a childcare vouchers scheme (max. £243 per month)			
k. Employer offers additional tax breaks on top of the typical £243 per month			
l. Working from home			
m. Other family friendly working arrangements			

19. Approximately what percentage of your time do you spend on the tasks below in an average week:

(a) during term-time (excluding exam periods)
(b) during the vacation (when undergraduate students are away)?

Please record the percentage of time you actually spend on the tasks rather than contracted time. If the time for any of the tasks is none, please enter "0". If you have two jobs, please provide the detailed information only for your main job as a percentage of your total hours in that job.

	Percentage of time spent on each area of work during a week in (a) Term-time (in %)	**Percentage of time spent on each area of work during a week in (b) Vacation (in %)**
a. Teaching (include contact hours, preparation, tutoring, marking essays/exams, supervision of postgraduate students)		
b. Administration and management (include personal admin., committee work and organisation, course admin., staff and other meetings, management of research projects and staff, etc.)		
c. Research (include lab. work, library research, field work, etc. and applying for grants and fellowships, include joint research with outside bodies)		
d. Training and conferences (attending courses, workshops and conferences)		
e. Clinical work		
f. Other		
g. TOTAL (should be 100%)		

Career and education history

20. Please indicate which was your main activity in each of the last 10 academic years. Your main activity is that which you were engaged in for the longest period of time in that year. Please read all columns before ticking any. If more than one applies, please tick the one closest to the left of the grid. Please enter a tick on each row. Include years during which you were in full-time education.

Please indicate which was your main activity in each of the last 10 academic years. *If more than one applies, please tick the one closest to the left of the grid.*

Academic Year	Full-Time Permanent Post in Higher Education (Academic/Academic Related)	Part-Time Permanent Post in Higher Education (Academic/Academic related)	Full-Time Fixed Term Contract in Higher Education (Academic/Academic Related)	Part-Time Fixed Term Contract in Higher Education (Academic/Academic related)	Research Job Outside Higher Education	Other Type of Employment Outside Academia/Research	PhD (Full Time or Part Time)	Looking After the Home or Family	Unemployed	Full-Time Education/Retraining
a. 2012–2011										
b. 2011–2010										
c. 2010–2009										
d. 2009–2008										
e. 2008–2007										
f. 2007–2006										
g. 2006–2005										
h. 2005–2004										
i. 2004–2003										
j. 2003–2002										

Academic qualifications

21. Please list all your academic qualifications. For pending awards (exams taken or thesis submitted but not yet awarded), please enter "pending" in the "Year of award" column. Please give all the information requested in the column headings.

	Qualification (i.e., BA Hons, MSc, PhD, etc.	**Year of Award**	**Institution**
a. 1st degree/qualification			
b. 2nd degree/qualification			
c. 3rd degree/qualification			
d. 4th degree/qualification			
e. 5th degree/qualification			
f. 6th degree/qualification			

Publication record

22. How many of the following have you had published in the last five years (i.e.: since January 2008)? Please include joint and single author publications, publications through consortia, articles "in press" and those available online but not on paper yet and "online only" as well. *If the answer for any category is none, please enter "0".*

	Number in the Last 5 Years
a. Articles in peer-reviewed journals:	
b. Conference proceedings:	
c. Guest-edited journal volumes:	
d. Chapters in books (if several chapters in one book record as 1):	
e. Entire books:	
f. Edited books:	

Other academic activities

23. Have you been involved in any of the following in the last five years (i.e.: since January 2008)? *Please tick one box in each row.*

	Involvement in the Last Five Years (i.e.: Since January 2008)	
	Yes	**No**
a. Membership of external research & professional committees/boards (e.g.: research council selection boards or committees, committees of professional societies)		
b. Refereeing and peer reviewing (e.g.: peer reviewing applicants for Research Councils, peer reviewing articles for journals & conference papers)		
c. Guest-editing journal volumes		
d. Being main editor of a journal (Editor-in-Chief, Associate Editor, etc.)		
e. Being on Editorial Boards of academic journals		
f. Invitations to present keynote speeches, lectures or chair sessions at conferences		
g. Presenting other papers at conferences		
h. Attending conferences without presenting papers		

i. External examiner at other HE institutions		
j. Assessor for RAE or REF		
k. Assessor for Teaching Quality Assessment		
l. Technology transfer/liaison with industry/industrial secondment		
m. Joint research/consultancy with other organisations (e.g.: government, charities)		
n. Visiting/exchange with other HE institutions (for a term or longer)		

24. Were you included in your department's 2008 Research Assessment Exercise (RAE)? *Please tick one only. (Optional)*
Yes
No
Not applicable (e.g., not in the department at the time)
I don't know

25. Will you be included in your department's 2014 Research Excellence Framework (REF)? *Please tick one only. (Optional)*
Yes, definitely
Yes, probably
No
Not applicable (e.g., not in the department at the time)
I don't know

Attitudes

26. Regardless of your gender and whether you have children or not, please answer the following question. Which of the following have been available to you in your academic or research career to date? If any of these are not relevant to you, please tick the 'Not applicable' box. *Please tick one box in each row.*

	Available to Me in My Academic or Research Career to Date		
	Yes, Available	**No, not Available**	**Not Applicable**
a. Flexible working arrangements (formally or informally)			
b. Part-time opportunities			
c. Good career guidance			
d. Influential role models and/or mentors			
e. Support from senior colleagues			
f. Support from other colleagues			
g. Knowing the 'right people' within my institution and/or outside			
h. Availability of good childcare			
i. Support from partner/spouse			

27. At this stage in your career, in order to gain promotion in your institution, how important is your performance in the following areas? *If any of these are not relevant, please tick the 'Not applicable' box.*

	To gain Promotion in Your Institution				
	Not Applicable	**Very Important**	**Fairly Important**	**Not very Important**	**Not at All Important**
a. Research					
b. Teaching					
c. Supervising postgraduate students					
d. Pastoral care/tutoring					
e. Student satisfaction/feedback from courses					
f. General administration					
g. Internal committee work					
h. Management of people					
i. Strategic and policy management (i.e.: contributing to the formulation and implementation of departmental/institutional policies)					
j. Publication record					
k. Presenting papers at conferences					
l. Income generating activities (winning research grants/links with industry & government departments)					
m. Interdisciplinary research					
n. External activities/representing the institution (e.g., on external committees, examining boards, in the media)					

Grants and commissioned research

28. Have you obtained any commissioned research contracts from industry, government departments, charities, etc. in the last five years (i.e.: since January 2008)?
    Yes
    No
    How many such research contracts have you obtained in the last five years (i.e.: since January 2008)? Please write in the number.
    Number obtained: … … … …

29. Have you been awarded any grants in the last five years, i.e., since January 2008? If Yes, please fill in the table but do not include commissioned research or contracts which were covered in the previous question. Please include the last six grants on which you were named as an applicant, even if you were not named as the principal applicant.

	Year of Award	Funding Body/Bodies	I Was			Duration of Funding	Duration of Funding					Level of Funding (Over Entire Duration of Award)			
			Principal Applicant/Investigator	Co-Applicant/Investigator	Co-Author/Recognised Researcher	Other type of employment outside academia/research	1 Year or Less	More than 1, up to 2 Years	More than 2, up to 3 Years	More than 3, up to 5 Years	More than 5 Years	<£15,000	£15,000–£29,999	£30,000–£99,999	>£100,000
a. 1st "most recent"															
b. 2nd															
c. 3rd															
d. 4th															
e. 5th															
f. 6th "least recent"															

30. Thank you very much for taking time to complete this survey. If you would like to add any comments about the issues raised in the questionnaire please do so below, on the understanding that we may anonymously quote part or all of what you write.

Appendix B

In this Appendix we explain why weights were needed to make our sample representative of the whole population, and how they were estimated.

Weights

The population of the study was all academic and research staff employed at the 24 Russell Group universities. Any member of the population belonging to a department linked to one of the 36 REF areas had the same probability of being invited to respond to the survey. The response rate may have varied according to a number of reasons, some of which were reported by the respondents themselves, such as for example, lack of time or concerns over privacy issues. There are no data on "lack of time" of the population, let alone "lack of time" during the weeks when the survey was live online, or how different individuals feel about disclosing personal information. Other reasons for non-response, and for which there are no population data either, include personal circumstances such as having or not having children under the age of 18 years (which may carry an inherent interest in the research in question but may also reduce the time a member of staff can afford to fill surveys in), personal tastes (i.e., liking or not liking surveys), altruism or selfishness (being prepared to collaborate with a researcher or not), etc.

The characteristics that could also influence response rates and for which there are some data, or at least proxies, on the population are gender, research area, and seniority. Needless to say, in order to correct for the potentially different response rates data on the population is essential. Thus, data for the whole population (academic and research staff at the 24 Russell Group universities) on gender, research area, and seniority was provided by the Higher Education Statistics Agency (HESA) on request, as explained below.

HESA Data on Gender

The HESA holds data on the legal sex of staff members, as opposed to the gender with which they identify [48].

HESA Data on Research Area

The HESA does not hold data on the area of research being carried out by each member of the population. However, it does hold data on "cost centers" and "staff members' qualifications". The cost centers tend to have similar cost structures for teaching and research, similar patterns for capital expenditure, academic coherence in terms of the academic disciplines of staff, and similar rates of funding for research grants and contracts. However, given the interdisciplinary characteristics of many departments across the 24 Russell Group universities, it is not unusual to see economists working in Geography departments or Schools of Business, and carrying out research in Economics, or Chemists working in Biology departments and carrying out research in Chemistry, or Physicists working in Chemistry departments and carrying out research in Physics, to name a few examples. For this reason, we decided to use the data on "staff members' qualifications", rather than the data on the number of staff associated to different cost centers. The HESA uses "academic discipline" to designate "the subject or subjects appropriate to that staff member's academic qualification", which although may "not necessarily be the academic subject in which that staff member may currently be teaching or researching" [48], has a much higher chance of being closely related to it than "cost centers".

HESA Data on Seniority

The HESA does not hold data on the grade at which each member of staff is employed (professor, reader, lecturer, etc.) but holds data on professorial role, i.e., professor or non-professor.

We grouped the 36 REF areas and the 146 different academic disciplines from the HESA in 16 areas. Table A1 shows the mapping. Table A2 shows the number of individuals in the sample and in the population in each of the 16 areas, also classified by gender and by whether they hold a professorial role or not.

Table A1. Our classification mapped against REF and HESA classifications.

Our Classification	REF Classification		HESA Classification	
Medical Sciences	1	Clinical Medicine	(A3)	Clinical medicine
Other Allied to Medicine	2	Public Health, Health Services and Primary Care	(A1)	Pre-clinical medicine
	3	Allied Health Professions, Dentistry, Nursing and Pharmacy	(A2)	Pre-clinical dentistry
	4	Psychology, Psychiatry and Neuroscience	(A4)	Clinical dentistry
			(A9)	Others in medicine & dentistry
			(B1)	Anatomy, physiology & pathology
			(B2)	Pharmacology, toxicology & pharmacy
			(B3)	Complementary medicine
			(B4)	Nutrition
			(B5)	Ophthalmics
			(B6)	Aural & oral sciences
			(B7)	Nursing
			(B8)	Medical technology
			(B9)	Others in subjects allied to medicine
			(C8)	Psychology
Life Sciences	5	Biological Sciences	(C1)	Biology
	6	Agriculture, Veterinary and Food Science	(C2)	Botany
	7	Earth Systems and Environmental Sciences	(C3)	Zoology
			(C4)	Genetics
			(C5)	Microbiology
			(C7)	Molecular biology, biophysics & biochemistry
			(C9)	Others in biological sciences
			(D1)	Pre-clinical veterinary medicine
			(D2)	Clinical veterinary medicine & dentistry
			(D3)	Animal science
			(D4)	Agriculture
			(D5)	Forestry

Table A1. *Cont.*

Our Classification	REF Classification		HESA Classification	
			(D6)	Food & beverage studies
			(D7)	Agricultural sciences
			(D9)	Others in veterinary sciences, agriculture
			(F6)	Geology
			(F7)	Science of aquatic and terrestrial environments
Mathematical, Physical Sciences and Computer Sciences	9	Physics	(F3)	Physics
	10	Mathematical Sciences	(F5)	Astronomy
	11	Computer Science and Informatics	(F9)	Others in physical sciences
			(G01)	Broadly based programmes in mathematical science
			(G02)	Broadly based programmes in computer science
			(G1)	Mathematics
			(G2)	Operational research
			(G3)	Statistics
			(G4)	Computer science
			(G5)	Information systems
			(G7)	Artificial intelligence
			(G91)	Others in mathematical sciences
			(G92)	Others in computer sciences
Social Sciences	21	Politics and International Studies	(L2)	Politics
	22	Social Work and Social Policy	(L3)	Sociology
	23	Sociology	(L4)	Social policy
	24	Anthropology and Development Studies	(L5)	Social work
	27	Area Studies	(L6)	Anthropology
			(L9)	Others in social studies
	28	Modern Languages and Linguistics	(P1)	Information services
	29	English Language and Literature	(P2)	Publicity studies
	30	History	(P3)	Media studies
	31	Classics	(P4)	Publishing

Table A1. *Cont.*

Our Classification	REF Classification		HESA Classification	
Humanities	32	Philosophy	(P5)	Journalism
	33	Theology and Religious Studies	(P9)	Others in mass communications & documentation
	36	Communication, Cultural and Media Studies, Library and Information Management	(Q1)	Linguistics
			(Q2)	Comparative literary studies
			(Q3)	English studies
			(Q4)	Ancient language studies
			(Q5)	Celtic studies
			(Q6)	Latin studies
			(Q7)	Classical Greek studies
			(Q8)	Classical studies
			(Q9)	Others in linguistics, classics & related subjects
			(R1)	French studies
			(R2)	German studies
			(R3)	Italian studies
			(R4)	Spanish studies
			(R5)	Portuguese studies
			(R6)	Scandinavian studies
			(R7)	Russian & East European studies
			(R8)	European Studies
			(R9)	Others in European languages, literature & related subjects
			(T1)	Chinese studies
			(T2)	Japanese studies
			(T3)	South Asian studies
			(T4)	Other Asian studies
			(T5)	African studies
			(T6)	Modern Middle Eastern studies
			(T7)	American studies
			(T8)	Australasian studies
			(T9)	Others in Eastern, Asiatic, African, American & Australasian languages, literature & related subjects

Table A1. *Cont.*

Our Classification	REF Classification		HESA Classification	
			(V1)	History by period
			(V2)	History by area
			(V3)	History by topic
			(V5)	Philosophy
			(V6)	Theology & religious studies
			(V9)	Others in historical & philosophical studies
Engineering	12	Aeronautical, Mechanical, Chemical and Manufacturing Engineering	(F2)	Materials science
	13	Electrical and Electronic Engineering, Metallurgy and Materials	(G6)	Software engineering
	14	Civil and Construction Engineering	(H0)	Broadly-based programmes within engineering & technology
	15	General Engineering	(H1)	General engineering
			(H2)	Civil engineering
			(H3)	Mechanical engineering
			(H4)	Aerospace engineering
			(H5)	Naval architecture
			(H6)	Electronic & electrical engineering
			(H7)	Production & manufacturing engineering
			(H8)	Chemical, process & energy engineering
			(H9)	Others in engineering
			(J1)	Minerals technology
			(J2)	Metallurgy
			(J3)	Ceramics & glasses
			(J4)	Polymers & textiles
			(J5)	Materials technology not otherwise specified
			(J6)	Maritime technology
			(J7)	Biotechnology
			(J9)	Others in technology

Table A1. *Cont.*

Our Classification	REF Classification	HESA Classification		
Economics and Econometrics	18	Economics and Econometrics	(L1)	Economics
Law	20	Law	(M1)	Law by area
			(M2)	Law by topic
			(M9)	Others in law
Business and Management Studies	19	Business and Management Studies	(N1)	Business studies
			(N2)	Management studies
			(N3)	Finance
			(N4)	Accounting
			(N5)	Marketing
			(N6)	Human resource management
			(N7)	Office skills
			(N9)	Others in business & administrative studies
Architecture and the Built Environment	16	Architecture, Built Environment and Planning	(K1)	Architecture
			(K2)	Building
			(K3)	Landscape design
			(K4)	Planning (urban, rural & regional)
			(K9)	Others in architecture, building & planning
Arts	34	Art and Design: History, Practice and Theory	(W1)	Fine art
	35	Music, Drama, Dance and Performing Arts	(W2)	Design studies
			(W3)	Music
			(W4)	Drama
			(W5)	Dance
			(W6)	Cinematics & photography
			(W7)	Crafts
			(W8)	Imaginative writing
			(W9)	Others in creative arts & design
Chemistry	8	Chemistry	(F1)	Chemistry

Table A1. *Cont.*

Our Classification	REF Classification	HESA Classification		
Education	25	Education	(X1)	Training teachers
			(X2)	Research & study skills in education
			(X3)	Academic studies in education
			(X9)	Others in education
Geography, Environmental Studies and Archaeology	17	Geography, Environmental Studies and Archaeology	(F4)	Forensic & archaeological science
			(F8)	Physical geographical sciences
			(L7)	Human & social geography
			(V4)	Archaeology
Sport and Exercise Sciences, Leisure and Tourism	26	Sport and Exercise Sciences, Leisure and Tourism	(C6)	Sports science
			(N8)	Hospitality, leisure, tourism and transport

Source: REF website (https://www.ref.ac.uk/2014/panels/unitsofassessment/) and data provided by HESA on request.

Table A2. Populations and sample individuals classified by area of research, gender, and professorial role.

Field	HESA DATA					SURVEY DATA				
	Prof + M	**Prof + F**	**Non-Prof + M**	**Non-Prof + F**	**Total**	**Prof + M**	**Prof + F**	**Non-Prof + M**	**Non-Prof + F**	**Total**
Medical Sciences	696	126	1396	1016	3234	4	4	8	11	27
Other Allied to Medicine	949	340	3889	5756	10934	23	26	78	201	328
Life Sciences	1128	264	5176	5027	11595	39	14	140	126	319
Mathematical, Physical Sciences and Computer Sciences	1458	159	5311	1503	8431	82	8	162	57	309
Social Sciences	416	192	1360	1665	3633	15	11	54	72	152
Humanities	871	323	2882	3153	7229	49	33	131	161	374
Engineering	729	37	3686	952	5404	17	3	89	26	135
Economics and Econometrics	393	61	857	485	1796	28	4	35	17	84
Law	249	104	511	498	1362	24	18	27	49	118
Business and Management Studies	215	49	677	571	1512	15	0	17	25	57
Architecture and the Built Environment	63	22	334	201	620	7	5	17	16	45
Arts	94	24	391	351	860	5	5	11	9	30
Chemistry	410	47	1687	709	2853	9	4	24	8	45
Education	58	41	397	821	1317	7	9	9	35	60
Geography, Environmental Studies and Archaeology	250	61	779	578	1668	16	9	29	44	98
Sport and Exercise Sciences, Leisure and Tourism	15	2	91	81	189	0	1	2	8	11
Total	7994	1852	29424	23367	62637	340	154	833	865	2192

Source: Responses from our survey and data provided by HESA on request. Note: "M" denotes male, "F" denotes female, "Prof" denotes professorial status, "Non-Prof" denotes non-professorial status.

As it can be seen from Table A2 the shares (not actually shown since we show the actual numbers) differ between the sample and the population. The reasons for this may be linked to the likelihood of different individuals to respond to the survey. This likelihood may vary with the three characteristics in question, gender, research area, and seniority. Non-response repartition is hardly the result of a random phenomenon. Some types of individual have been over-sampled, and some have been under-sampled, and as a consequence, the distribution of these three characteristics across the sample is different from that of the population. This would introduce bias in any estimate.

In order to correct for survey non-response and reduce any potential bias in the estimates we used weights. The method essentially consists of increasing the weight of the sample respondents to take into account the population of non-respondents. The method chosen is based on the mechanism of homogeneous response within subpopulations. Therefore, the Russell Group population is assumed to be homogeneous concerning non-response within well-chosen subpopulations.

The data from the sample was thus weighted using post-stratification survey weights so that the sample would reflect the distribution of academics in the 24 Russell Group universities according to gender, professorial role (or not) and area of research.

Before applying any weights, we tested whether these were indeed needed. Using the population data provided by HESA, we created a database of 62,637 individuals representing the whole Russell Group population, and therefore containing the three characteristics (gender, area of research, and professorial role). Once we had this database we created a dummy variable Y and assigned a "1" to our survey respondents (contained in the population) and a "0" to everyone else in the population (not included in our sample). The following step was to regress the zero-one response indicator on the three variables (gender, area of research, and professor marker). We used logistic regression for this, following [41,42].

Table A3 shows the results of a logistic regression run for gender, professor marker, and area of research. Table A4 shows the results of the same logistic regression run excluding the gender variable.

Table A3. Logistic regression of response indicator on gender, professor marker and area of research.

Variable	Coefficient	*P*-Value
Gender	0.375 (0.045)	0.000
Professor marker	0.559 (0.054)	0.000
Area of research	0.044 (0.005)	0.000
Constant	−4.208 (0.081)	0.000
Log likelihood	−9403.38	
Number of obs	62637	
LR chi2	197.17	
Prob > chi2	0.0000	
Pseudo R2	0.0104	

Note: Standard errors in parenthesis. Gender denotes gender (male or female), professor marker denotes professorial role (either a professor or a non-professor) and area of research denotes one of our 16 areas of research. The independent variable is a dummy variable, which is the response-non-response indicator.

The results show that all three variables were significant in determining whether an individual responded to the questionnaire or not. As we can see, gender seems to have a significant impact on the probability of response to the survey, as when we break by gender, other variables have less explanatory power. The coefficient for the gender variable (coded 0 for man and 1 for woman) is positive and statistically significant, showing that women were more likely to respond to the survey. The log likelihood and pseudo-R squared are also higher when gender is included.

The conclusion from Tables A3 and A4 was therefore that non-response adjustments according to gender, area of research, and professorial role were required and for that we used weights.

Table A4. Logistic regression of response indicator on professor marker, and area of research.

Variable	Coefficient	*P*-Value
Professor marker	0.459 (0.052)	0.000
Area of research	0.042 (0.005)	0.000
Constant	−3.641 (0.041)	0.000
Log likelihood	−9437.73	
Number of obs	62637	
LR chi2	128.46	
Prob > chi2	0.0000	
Pseudo R2	0.0068	

Note: Standard errors in parenthesis. The variables are defined as in Table A3.

Once the subpopulations were defined, the probability of response of all members of that subpopulation was assumed to be the same, i.e., constant within the subpopulation, in line with the mechanism of homogeneous response within subpopulations, as already highlighted above. In addition, this probability was assumed to be independent from the probabilities of response of all the other subpopulations.

When the size of each subpopulation is known there is no need to estimate the probabilities to respond using a logistic regression, as post-stratification estimators are better [42]. The method based on estimated probabilities of response does not allow any control over the dispersion of values. Indeed, the estimator can become very unsteady because of very under-represented types of respondents, which have high weights assigned to them. As argued in [42], the construction of homogeneous groups of respondents conveys more robustness, especially when the model of regression is not accurate.

The weights in our case can therefore be simply estimated by the ratio:

$$w_h = \frac{N_h}{r_r}$$

where $h = 1 \ldots 64$ and h denotes the 64 different strata, i.e., the 64 possible combinations of characteristics an individual can have (male, female; professor, non-professor, and one of 16 different research areas), r_r is the number of respondents of subpopulation h (i.e., that were included in the sample), N_h is the size of subpopulation h.

The problem we have (and we would still have even if we were to use a logistic regression to estimate probabilities of response) is that, as Table A2 clearly shows, in two cases we have zero respondents in our sample (i.e., $r_r = 0$. The two subpopulations in question are female professors in Business and Management Studies and male professors in Sport and Exercise Sciences, Leisure and Tourism. Division by zero does not exist and therefore $w_h = \frac{N_h}{r_r}$ cannot be computed. As a solution, we merged Business and Management Studies with Economics and Econometrics and Education with Sport and Exercise Sciences, Leisure and Tourism. The rationale behind the first merge was that many economists work in Business and Management Studies Schools and also academics doing research in Business and Management Studies and academics doing research in Economics and Econometrics share some similarities regarding training. They tend to hold first degrees, masters, and PhDs and often these are gained from departments that have both Economics and Business. The rationale behind the second merge was that the years and type of training tend to be similar. Many academics in those areas do not actually hold PhDs, but they hold postgraduate diplomas and certificates, often requiring about one year of full-time equivalent study/training.

As underlined in [42], the number of subpopulations is the result of a problematic trade-off between increasing the number of strata (ensuring great homogeneity within each stratus) and lowering the number of strata (ensuring a lower variance of the estimator). Once the problematic cells with zeros, which made the calculation of ratios impossible, disappeared, the ratios were computed.

Table A5 shows the weights computed as the ratios of the size of the subpopulation with characteristics h to the size of the subsample with characteristics h.

Table A5. Weights computed as ratios.

	Prof + M	Prof + F	No Prof + M	No Prof + F
Medical Sciences	174	31.5	174.5	92.36
Other Allied to Medicine	41.26	13.08	49.86	28.64
Life Sciences	28.92	18.86	36.97	39.9
Mathematical, Physical Sciences and Computer Sciences	17.78	19.88	32.78	26.37
Social Sciences	27.73	17.45	25.19	23.13
Humanities	17.78	9.79	22	19.58
Engineering	42.88	12.33	41.42	36.62
Law	10.38	5.78	18.93	10.16
Economics and Econometrics. Business and Management Studies	14.14	27.5	29.5	25.14
Architecture and the Built Environment	9	4.4	19.65	12.56
Arts	18.8	4.8	35.55	39
Chemistry	45.56	11.75	70.29	88.63
Education. Sport and Exercise Sciences. Leisure and Tourism	10.43	4.3	44.36	20.98
Geography, Environmental Studies and Archaeology	15.63	6.78	26.86	13.14

Source: Table A2.

The weight coefficients for professor and for non-professor are higher for females than for males in all research areas, except for Medical Sciences. This shows that women had been over-represented among the respondent population. Given the subject (and the results of the logistic regressions shown on Tables A3 and A4), it is not a surprise that women were more prone to respond to our survey than men.

We also note that the difference of weight coefficients between the professor and non-professor subpopulations is much stronger in the female subpopulation than in the male subpopulation. Hence, a women professor is the subpopulation most over-represented in our survey respondents.

The weights computed in Table A5 were used in all our models to make our sample representative of the population.

Appendix C

In this Appendix we present the results of the linear regressions of the research productivity variables, discussed in Sections 5.2 and 5.3.

Table A6. Linear regressions of research productivity variables on gender, area of research, grade and number of children under 18.

	Number of Journal Publications	Number of Conference Proceedings	Number of Grants
Gender	−2.241 *	−0.197	0.199
	(1.172)	(0.721)	(0.125)
Area 1 (Science) *Reference*			
Area 2 (Medicine and Life Sciences)	−1.849	−4.584 ***	−0.065
	(2.365)	(1.235)	(0.182)
Area 3 (Social Sciences)	−12.653 ***	−7.613 ***	−0.938 ***
	(2.227)	(1.028)	(0.154)
Area 4 (Arts and Humanities)	−15.064 ***	−9.092 ***	−1.122 ***
	(2.315)	(1.067)	(0.155)
Grade	4.490 ***	1.391 ***	0.429 ***
	(0.660)	(0.343)	(0.050)
Number of children under 18	0.567	−0.090	0.213 ***
	(0.616)	(0.406)	(0.062)
Constant	9.259 **	7.144 ***	0.495 *
	(3.942)	(1.624)	(0.253)
Number of obs	1380	1380	1380
F	F (6, 1373) = 40.03	F (6, 1373) = 17.63	F (6, 1373) = 29.47
Prob > F	0.0000	0.0000	0.0000
R-squared	0.1026	0.0912	0.1408
Root MSE	25.847	11.94	1.839

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

Table A7. Linear regressions of research productivity variables on gender, area of research, grade, number of children under 18 and percentage of time spent on teaching and teaching-related activities.

	Number of Journal Publications	Number of Conference Proceedings	Number of Grants
Gender	−1.724	−0.053	0.220 *
	(1.156)	(0.722)	(0.124)
Area 1 (Science) *Reference*			
Area 2 (Medicine and Life Sciences)	−2.821	−4.854 ***	−0.105
	(2.431)	(1.229)	(0.180)
Area 3 (Social Sciences)	−12.253 ***	−7.501 ***	−0.921 ***
	(2.175)	(1.030)	(0.155)
Area 4 (Arts and Humanities)	−13.973 ***	−8.789 ***	−1.077 ***
	(2.206)	(1.083)	(0.159)
Grade	4.023 ***	1.262 ***	0.410 ***
	(0.663)	(0.354)	(0.051)
Number of children under 18	0.566	−0.090	0.213 ***
	(0.605)	(0.406)	(0.062)
Share time on teaching	−0.128 ***	−0.036 *	−0.005 *
	(0.028)	(0.018)	(0.003)
Constant	14.860 ***	8.702 ***	0.727 ***
	(4.490)	(1.814)	(0.280)
Number of obs	1380	1380	1380
F	F (7, 1372) = 35.83	F (7, 1372) = 15.81	F (7, 1372) = 25.74
Prob > F	0.0000	0.0000	0.0000
R-squared	0.1110	0.0943	0.1435
Root MSE	25.735	11.924	1.8367

Note: Standard errors are in parenthesis. * (**) (***) indicate statistical significance at the 10 (5) (1) % levels.

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