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The reverse engagement gap: gender differences in external engagement among UK academics

Cornelia Lawson [a] and Ammon Salter [b]

[a]Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester, Manchester, UK; [b]School of Management, University of Bath, Bath, UK

ABSTRACT

Examining academics 'engagement with non-academics in industry, public agencies and charities, this paper examines gender gaps between men and women. Using a large-scale survey of UK academics, we find that although there is difference between women and men in the commercial areas of engagement, with men being more active in this domain than their women colleagues of a similar age and experience and of the same rank, discipline, and university, this pattern is reversed for academic engagement with the third sector, with women more likely to engage with charities, regardless of career stage and research field. We explore the gendered nature of academic engagement, and discuss policy implications arising from it.

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Gender; academic engagement; women in science; third sector engagement; academic entrepreneurship

1. Introduction

The promotion and enhancement of women's presence at all levels of science has been in the forefront of science policy in recent years. An important aspect of academic's role in science is their engagement with non-academic institutions and actors; important for innovation in research and for impact on society. Studies have shown that women scientists engage less with industry compared to men, which is reflected in lower rates of patenting, invention disclosures, consulting, contract research, board membership and start-ups (Whittington and Smith-Doerr 2005; Murray and Graham 2007; Colyvas et al. 2012; Ding, Murray, and Stuart 2013; Tartari and Salter 2015; Lauto, Salvador, and Visintin 2022). Research has also shown that when important contextual and personal characteristics are accounted for, such as the level of research funding (Colyvas et al. 2012), or institutional support (Tartari and Salter 2015; Giuri et al. 2020), these differences are much less pronounced or even disappear.

Yet, prior research has tended to focus on interactions with industry or commercial forms of knowledge transfer, and therefore observed only a narrow range of academics' external engagement. More recently, there is a growing interest in academic engagement with other types of organisations, such as those in the public and third sector, as well as forms of engagement that do not target commercial exploitation, such as the direct involvement with the public (Beck et al. 2022). This new research stream opens up a more varied and richer picture of academic engagement, recognising its diversity and scope. Indeed, it is clear that commercial activities, such as patenting and start-up formation, also represent only a small part of possible engagement activities (Abreu

CONTACT Cornelia Lawson cornelia.lawson@manchester.ac.uk Alliance Manchester Business School, University of Manchester, Booth St W, Manchester M15 6PB, UK

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and Grinevich 2013). It may be that these other types of engagement are more attractive to women. For instance, in the UK and the US more than 60% of the workforce in the public and third sectors are women (Stater and Stater 2019; OECD 2015; NCVO 2021), largely explained by occupational segregation, which also affects academia (Frehill, Abreu, and Zippel 2015). This occupational segregation may also be carried over into academics' engagement with non-academic sectors, such that the engagement gap commonly observed may be less pronounced for non-commercial engagement activities and for knowledge exchange with the public and third sectors. We build on previous research that had identified areas where men and women are at level pegging, such as for public sector consulting and standard setting in Germany (Fudickar, Hottenrott, and Lawson 2018; Blind, Pohlisch, and Zi 2018). By examining a wider range of academic engagement activities and sectors that go beyond the university-industry nexus, we hope to extend this emerging understanding of potential (reverse) gender gaps in engagement.

To do so, we make use of a large web-based survey of academics, which we conducted with the Centre for Business Research (CBR) in 2015. The survey explored a variety of engagement activities including commercialisation, joint research, teaching exchanges as well as presentations to the public, and considered activities with a variety of non-academic sectors (Hughes et al. 2016). Considering a wider range of activities will allow us to shed light on those areas where gender gaps can be observed, which has implications for which areas of external engagement may be valued or undervalued, with implications for university management and policy.

2. The gender difference in academic engagement

The engagement of academics with non-academic organisations has remained at the forefront of policy and scholarly interest (Perkmann et al. 2021). Academic engagement in this context is understood as "knowledge-related collaboration by academic researchers with non-academic organisations" (Perkmann et al. 2013: 424), and includes different formal and informal activities, ranging from joint research to public lectures (Lawson et al. 2019). Within this literature, we have seen the impact of demographic factors on engagement, with gender receiving particular attention. Several studies showed that women academics engage less with industry (Tartari and Salter 2015; Abreu and Grinevich 2017) and in fewer types of engagement activities (Iorio, Labory, and Rentocchini 2017). Explanations for these gaps are often rooted in attempts to explain more general gender differences in science, such as the lower rate of publishing (Cole and Zuckerman 1984), differences in grant receipt (Lerchenmueller and Sorenson 2018; Belz et al. 2022), and career progression (Frehill, Abreu, and Zippel 2015; Howe-Walsh and Turnbull 2016). Prior research has tried to pin down the reasons for gender inequality in science, highlighting differences between men and women with regard to domestic responsibilities (Ceci and Williams 2011; Howe-Walsh and Turnbull 2016; Lawson, Geuna, and Finardi 2021), or attitudes towards risk, money and competition that could prevent women from active participation in all aspects of science (Stephan and El-Ganainy 2007; Frehill, Abreu, and Zippel 2015). Taking these differences between men and women into account, prior research has shown that the gender gap in commercial forms of engagement narrows considerably (though does not disappear) when a more comprehensive set of personal characteristics, such as seniority, research funding and publication performance, is considered (Colyvas et al. 2012; Abreu and Grinevich 2017).

Other authors point towards general difficulties in research due to women's less diverse and rich social networks and the lack of role-models (Etzkowitz, Kemelgor, and Uzzi 2000; Frehill, Abreu, and Zippel 2015), leading to a perception of exclusion (Maranto and Griffin 2011; Howe-Walsh and Turnbull 2016), which may also be felt in opportunities for academic engagement. Women may feel alienated from often informal male dominated 'old-boys' networks (Howe-Walsh and Turnbull 2016), which appear to be particularly important for linkages and collaboration with industry (Bodas Freitas, Geuna, and Rossi 2013; Bekkers and Bodas Freitas 2008). According to Maranto and Griffin (2011), the perception of exclusion is less pronounced when there is a higher representation of women in

the department. In the same vein, role models are particularly important for engagement intentions to emerge amongst female academics (Di Paola 2021). Gender research has also stressed the importance of gender-role congruence and gendered structural constraints (Karataş-Özkan and Chell 2015; Frehill, Abreu, and Zippel 2015), which influences motivations of men and women but may also determine where an audience expect expertise to manifest (Smeding 2012; Cardador 2017). This could mean that women may be less likely to be called upon as experts in, e.g. areas of engineering research, where commercial forms of engagement and with industry are particularly relevant.

The above discussion has focused the areas where women may perform fewer activities than their male colleagues. Yet there are reasons to suspect that this balance may shift when a broader set of engagement patterns are examined. First, women academics have been shown to dedicate more time to teaching or administrative tasks compared to their male colleagues (Guarino and Borden 2017; Babcock et al. 2017). However, these activities are often considered to be of 'low promotability' in the academic system (Babcock et al. 2017). Also outside of academia, women engineers find themselves 'promoted' into managerial roles, and away from science and research (Cardador 2017). As Meng (2016) suggests, we view "men to be more proactive and competent in general and especially highly competent at the things that 'count most' in society; and view women to be less competent generally but better at more feminine, communal tasks that tend to be socially less valued" (Meng 2016: 57). In case of academic engagement, it is possible that women tend to take up those forms of engagement that are considered of 'lower status', mirroring gender differences in relation to teaching and administration. Engaging in non-commercial activities and working with charities or public agencies may not yield outputs and impacts that are easy to trace or evidence. Moreover, they may lack the status or perceived importance that industry partners command for university attention. Such engagement efforts may be more commonly performed by women, even though they are less visible and prominent.

Second, although women have weaker links to industry than men, they may be more successful in building connections and engage with other sectors. Prior studies have shown that women academics have a larger number of collaborators within academia (Bozeman and Gaughan 2011) and more often have links to government or other public sector organisations compared to men (Meng 2016). Here the disadvantage of women's minority positions in the science and technology labour market is reversed, as women make up most of the employees of potential external partners in the public and third sectors (Stater and Stater 2019; OECD 2015). The presence of a large pool of same gender collaborators may make it easier for women to find potential partners, shifting away from the 'old boys' culture of industry engagement towards more of the 'feminist circle' culture of public and charitable engagement. Indeed, male academics might find it harder to find common ground with women in positions of authority and power in the public and third sectors than their female colleagues.

Thus, we expect that women may be more likely to direct their efforts at areas of academic engagement that provide higher meaning and worth in their professional roles but are not as widely studied or promoted, and to focus on engagement efforts in domains where they are liable to find greater opportunities to find same gender collaboration partners.

3. Data and methodology

We draw on the large-scale CBR survey of academic engagement in the UK targeting academics active in teaching and/or research at all UK universities in the arts and humanities, social sciences, engineering, life science and natural sciences (Hughes et al. 2017). To identify academic staff, we manually collected lists of all academics in all departments and faculties from the websites of UK universities. This yielded a sample frame of around 140,000 academics with known email addresses to which a web-based questionnaire was addressed. We received complete responses from 18,177 academics (13% response rate).[1] After removing respondents that are retired, in teaching only contracts or in research assistant positions, and those that have missing values in any of the variables of

interest, we are left with a sample of 14,413 academics. The survey asked about the engagement with external, non-academic, institutions in the pre-survey period from 2012 to 2015, and also included questions on other personal and professional aspects.

We complemented the data with publication data from Scopus for the years 2009–2015, thus covering the survey period and the four years prior to the survey period. We first adopted an automated approach using Python, matching on last name and initial for authors with unique names, discarding any, where we observed any inconsistencies, such as publications in a subject area or institution different to the focal academic. This process returned publications for about 10,000 survey respondents. In a second step, we widened the Scopus search for the remaining respondents and manually checked search results, also considering publication lists on personal websites to guide the search. This process resulted in a final sample of 12,262 academics.[2] This includes 4861 women and 7401 men.

3.1. Dependent variable – academic engagement

The main variable of interest is engagement activity. We firstly exploit a question on the sector of external engagement, with private, public and third sector organisations. Respondents were presented with a list of examples of such organisations and asked whether they had any exchanges with these sectors in the previous three years. This permits us to build three dummy variables of engagement with each sector. Overall, 31% of respondents report engagement with the private sector, 35% with the public sector and 40% with the third sector. This already indicates the importance of sectors other than industry for academic engagement.

The survey further asked questions on 27 different types of non-commercial engagement and four types of commercialisation channels, including the frequency with which each is used (regardless of sector of engagement), ranging from 0 to 10+. All activities are listed in Table A1. We categorise activities into five groups: training, research, meetings, commercialisation and public engagement[3] and build academic engagement indices (AEI) following Bozeman and Gaughan (2007) and Tartari and Salter (2015). To do so, we use the frequencies with which different activities are used, computing the mean frequency of engagement over all academics for each activity. The individual index is then constructed by multiplying the frequency with which academic *i* engages in the activity by its mean occurrence, and summing all the scores within each engagement category. The index thus accounts for the difficulty with which each activity within it can be performed and/or its scarcity. The final AEIs range from 0 to 47. The highest mean is in meetings with 6.6 (median = 4.3) and the lowest in commercialisation with 0.8 (median = 0).

3.2. Sample characteristics by gender

Women make up 40% of respondents in our sample. Table 1 reports descriptive statistics by gender on a number of demographic and professional characteristics. The comparison shows that women are significantly younger and in lower-ranked positions compared to men. They are overrepresented in all subject areas with the exception of STEM. They are also less likely to have received funding as a PI, publish fewer articles, are less cited, and have fewer co-authors on average.

3.3. Methodology

Studying differences in external engagement between men and women is made difficult due to significant underlying differences between men and women, as represented in Table 1. Ignoring these differences in the analysis of gender differences in external engagement may bias estimates of gender effects. To address such biases, we employ matching estimators and report differences between female academics and their matched male counterparts. We employ a semi-parametric matching method, which has the advantage over parametric models that it avoids assumptions about functional forms and error term distributions (Rubin 1977; Rosenbaum and Rubin 1983). We

Table 1. Descriptive statistics by gender.

	Full sample (12,260)					Matched sample		
			Men	Women		Men	Women	
			7399	4861		2406	2406	
	mean	sd	mean	mean		mean	mean	
Professor	0.245	0.430	0.298	0.164	***	0.168	0.168	
Senior lecturer/Reader	0.329	0.470	0.322	0.342	**	0.327	0.327	
Lecturer	0.202	0.402	0.186	0.228	***	0.186	0.186	
Post-doc	0.223	0.417	0.195	0.268	***	0.319	0.319	
Social sciences	0.242	0.428	0.222	0.273	***	0.235	0.235	
Life sciences, health	0.366	0.482	0.319	0.438	***	0.477	0.477	
Arts and humanities	0.124	0.329	0.109	0.147	***	0.108	0.108	
STEM	0.268	0.443	0.351	0.142	***	0.180	0.180	
Age under 40	0.334	0.471	0.313	0.365	***	0.404	0.401	
Age 40–49	0.290	0.454	0.272	0.319	***	0.300	0.300	
Age 50 and over	0.376	0.484	0.416	0.317	***	0.296	0.298	
Foreign-born (0/1)	0.381	0.486	0.379	0.384		0.413	0.410	
Research time spent on (in %):								
Basic research	32.340	35.184	34.846	28.526	***	32.514	30.093	**
Applied research	40.368	35.856	37.543	44.668	***	41.019	42.613	
UKRI PI funding (0/1)	0.137	0.344	0.158	0.107	***	0.119	0.122	
# publications (2009-12)	8.089	15.385	9.915	5.308	***	5.833	6.231	
Avg. # citations (2009-12)	16.029	26.272	16.803	14.852	***	17.442	17.302	
Avg. # coauthors (2009-12)	4.248	7.757	4.518	3.837	***	4.252	4.563	

Note: *$p < .05$, **$p < .01$, ***$p < .001$; Co-author number capped at 100.

match each woman in our population to a man with similar characteristics, using a propensity score that summarises a wide set of observable characteristics. Specifically, we match on age, on whether a researcher was born abroad, and on academics' research orientation, characteristics that have been associated with external engagement in prior research (Perkmann et al. 2021). We also account for a number of scientific performance measures in terms of number of publications, citations and co-authors in the pre-survey period 2009–2012, and research funding receipt during the 2012–2015 period. In addition, we reduce possible bias by combining the propensity score matching with elements of an exact matching (EM) procedure to avoid bad matches for important characteristics. Here we match each woman to a man of the same academic rank, working in the same university and same disciplinary field (considering 17 subfields), as they are likely subject to the same incentives and evaluation criteria (also used in Lawson et al. 2019). Using the strict EM criteria a match is found for 2406 women academics, that is 49% of women in the sample (detailed protocol in online Supplement). After the matching procedure, there is no significant difference between the treated and the control group (see online Supplement)

4. Results

4.1. The engagement gap

Table 2 reports two sets of results for our measures of academic engagement, (1) the predictive margins for the full sample of academics, and (2) the average treatment effect on the treated academics (ATT) for the matched sample. The pre-matching comparison between men and women (model 1) reveals that, after controlling for all observables, significantly fewer women report activities with private organisations (−2.3%), but that far more engage with non-private organisations compared to men (+9%). After matching (model 2), these differences are confirmed, providing strong evidence of a reverse engagement gap. However, any difference with regard to public sector engagement disappears after matching. The results also show that for both, women and men, the share interacting with the third sector is higher than that for the private and also public sectors.

Table 2. Academic engagement by gender, before and after matching.

	(1) Predictive margins before matching[a]			(2) ATT after matching[b]		
	Women	Men		Women	Men	
Sector of engagement						
Private sector	0.300	0.323	***	0.259	0.287	*
Public sector	0.364	0.339	***	0.354	0.333	
Third sector	0.449	0.359	***	0.448	0.351	***
AEI						
Training	2.829	2.923		2.581	2.538	
Meetings	6.387	6.650	**	5.901	6.337	*
Research	4.206	4.506	***	3.806	4.074	
Commercialisation	0.642	0.939	***	0.486	0.743	***
Public engagement	3.074	3.027		2.780	2.758	

Note: ***,**,* indicate a significance level of 1%, 5%, 10%.
[a]Controlling for all covariates and university, discipline, seniority fixed effects.
[b]ATT based on Lechner-adjusted standard errors (Lechner 2001).

In terms of engagement channels, the pre-matching results in Table 2 (model 1) show that men engage more actively in meetings, research, and commercialisation activities with external organisations than women. After matching (model 2), we confirm than men have a much higher commercialisation score. Importantly, we find no difference by gender in terms of other, non-commercial forms of engagement, namely research, teaching, and public engagement, while the difference in terms of meetings is much reduced. This suggests that commercialisation is the one area where women are lagging behind men.

4.2. Female representation and the engagement gap

In Table 3, we report engagement broken down by disciplinary fields that differ in the participation rate of women, considering fields with high (>50%) and low (<30%) female representation. While women represent more than 50% of academic staff in some areas of medicine and humanities, they account for fewer than 20% in engineering and fewer than 30% in other STEM disciplines.[4] In terms of sector of engagement, women do not show significantly less engagement with industry in areas with lower female representation. We further see that they are more likely engaged with third sector organisations compared to men, regardless of female representation within the field, but the difference is much larger in STEM disciplines, with women being 40% more likely than men to report third sector engagement (18% in fields with high female representation).

Looking at channels of engagement, we find that the gender gap in commercialisation exists in areas of high and low female representation, but is larger in the latter (70% vs. 50% higher AEI

Table 3. ATT by field of low vs high female representation by gender, after matching.

	(1) Low female representation[a]			(2) High female representation[b]		
	Women	Men		Women	Men	
Sector of engagement						
Private sector	0.353	0.391		0.204	0.249	
Public sector	0.241	0.192		0.468	0.465	
Third sector	0.289	0.167	***	0.535	0.435	***
AEI						
Training	2.132	2.078		3.152	2.836	
Meetings	5.047	5.082		6.501	6.925	
Research	4.889	5.220		3.747	4.265	
Commercialisation	0.926	1.565	***	0.379	0.562	*
Public engagement	2.743	1.965	***	2.235	2.509	

Note: ***,**,* indicate a significance level of 1%, 5% 10%. ATT based on Lechner-adjusted standard errors (Lechner 2001).
[a]<30% women in the field (STEM).
[b]>50% women in the field (e.g. psychiatry, nursing, languages, education).

compared to women). In fields of low female representation, we also find significantly higher public engagement for women compared to men. An explanation for this could be the drive for increased visibility of women in STEM fields to encourage more young girls and women into the field (creating role models through activities such as 'women in science'). By contrast, women are equally as likely as men to do public engagement in fields with high female representation, corroborating this interpretation but perhaps also indicating that higher representation may allow women to remove themselves from more 'feminine' tasks.

4.3. Age and the engagement gap

Another factor that could explain gender differences is that women, especially junior women may remove themselves from engagement due to care responsibilities. In absence of information on care responsibilities, we compare women in different age brackets to their matched male counterparts (Table 4). In all age groups, women demonstrate a higher propensity to engage with the third sector. The difference in terms of private sector engagement is only observed for women in the 40–49 age bracket. We further observe lower engagement in commercialisation and research for women under the age of 40 compared to their male counterparts working in the same departments. However, for women above the age of 50, we also find less engagement in commercialisation compared to matched men (in the 40–49 group these differences are insignificant) but no differences in other types of engagement activities. These findings suggest that women may be at a disadvantage at early career stages, potentially due to less developed networks, observable in lower involvement in external research and meetings, and greater care responsibilities or other competing priorities. In contrast, young men may be able to leverage informal networks and avoid similar care responsibilities, allowing them to partake in commercialisation-focused engagement. This may have knock-on effects for career advancement and thus contribute to the gender gap observed in science more broadly. Senior women, those that did not leave academia and are just as successful as men in their careers, are at level pegging with regards to all engagement activities except commercialisation, and indeed show more engagement with the public and third sectors.

4.4. Sector and channels of engagement

An additional question that arises is how sectors of engagement and engagement channels relate to one another. We cannot investigate this question directly as the survey did not cover this, but we can compare responses across the questions. In Table 5, we therefore report predicted AEIs in cases where respondents indicated engagement with each respective sector by gender. We find that men who engage with the private sector are more active in meetings and commercialisation compared to

Table 4. ATT by age group and gender, after matching.

	(1) Age < 40			(2) Age 40–49			(3) Age > 50		
	Women	Men		Women	Men		Women	Men	
Sector of engagement									
Private sector	0.237	0.234		0.268	0.336	**	0.278	0.309	
Public sector	0.247	0.256		0.362	0.376		0.492	0.395	***
Third sector	0.368	0.287	***	0.470	0.369	***	0.535	0.418	***
AEI									
Training	1.722	1.807		2.642	2.81		3.675	3.246	
Meetings	4.082	4.686	**	6.148	6.854	*	8.097	8.037	
Research	2.965	3.361	*	3.863	4.213		4.877	4.893	
Commercialisation	0.464	0.722	**	0.497	0.659		0.504	0.855	***
Public engagement	2.184	2.068		3.302	2.939		3.054	3.504	

Note: ***,**,* indicate a significance level of 1%, 5% 10%. ATT based on Lechner-adjusted standard errors (Lechner 2001). Age is age of women; difference is estimated between matched pairs, even if men have different ages.

Table 5. Sector and channels of engagement by gender, after matching.

	Private sector			Public sector			Third sector		
	Women	Men		Women	Men		Women	Men	
AEI									
Training	4.11	4.29		4.07	4.07		3.64	3.75	
Meetings	8.38	9.35	**	9.21	9.29		8.07	9.30	*
Research	5.96	6.04		5.57	5.47	*	4.84	5.21	
Commercialisation	1.04	1.55	***	0.59	0.89		0.62	0.81	
Public engagement	3.63	3.71		3.64	4.01	*	4.12	5.10	***

Note: ***,**,* indicate a significance level of 1%, 5% 10%. Predicted AEI for engagement with different sectors by gender.

women who engage with the private sector. This may indicate that women are not networking with private firms to the same extent and are less able to leverage links for commercialisation. Instead, women with public sector links, show a little more research engagement compared to men, indicating that they can successfully leverage such links for joint research, though the differences are small. Finally, we find that men who engage with the public and third sector show a higher public engagement score compared to women with such links. This suggests that they are more likely to consider such connections as less complementary to their research compared to women.

5. Conclusions

Drawing on a large sample of UK academics, we find that the engagement gap between women and men in science is concentrated in the commercial areas of engagement, with men being more active in this domain than their women colleagues of a similar age and experience and of the same rank, discipline, and university, a finding that is consistent with prior work (Whittington and Smith-Doerr 2005; Colyvas et al. 2012; Tartari and Salter 2015). At the same time, our results do not suggest that women are more likely to engage in activities that are considered less promotable and more 'feminine' such as public lectures or training.

Yet, we find new and compelling evidence that women are more active in engaging with third sector organisations than their male colleagues. This suggests that the engagement gap goes both ways with women leading in third sector engagement. As such, charities may provide a viable route for women scientists to generate external engagement and impact. Relationships in this sector may be easier to establish due to the high need and very different culture compared to some science and engineering industries, which are male dominated. Women are also at level pegging with regard to public sector engagement, which adds to prior evidence in Germany (Fudickar, Hottenrott, and Lawson 2018; Blind, Pohlisch, and Zi 2018).

There are several limitations to this work, which also open research possibilities. First, our study is focused on the UK and therefore it is not clear whether gender gaps become weaker (or stronger) in a different institutional context. Moreover, during the period of our study, UK academics were subject to increasing pressure to align and document their efforts to enable the 'impact', which was embedded in the national research assessment and funding councils' decision-making. As a result, some universities updated and extended their recruitment, promotion and reward systems to recognise impact with non-academic audiences. It is not clear what the effect of these changes is on engagement attitudes and behaviours with respect to engagement over time and among different genders. It may be that engagement with the third sector is increasingly perceived equally visible and prominent as engagement with private or public actors. At a minimum, universities and research councils need to value the diversity of academic engagement, such as developing criteria for promotion that equally values commercial output with social impacts. Second, since our study suggests women appear to engage more actively than their male colleagues in the third sector, more research is required to understand what potential barriers men perceive from these types of engagement. For example, training programmes could be developed to try to get male academics to more effectively engage with third-sector actors, rather than simply attempting to

encourage more women into commercialisation. Third, efforts to strengthen relationships among women in fields where their representation is currently low and commercialisation is more common may help to address the gender gap. This could involve creating mentoring programmes, shadowing and industrial sabbaticals among women in STEM in both industry and academe to build richer relationships. Such efforts might help to counteract the extreme gender stratification of scientific and technical careers that pervades many advanced economies. Finally, while matched pair analysis allows us to arrive at more robust comparisons between women and men, there are some drawbacks to using this method of analysis, especially as no match could be found for a significant section of our sample. In particular, we may underestimate some of the difficulties facing women and advantages enjoyed by men, as especially more senior men were more likely to be excluded from the matched sample frame.

Notes

1. A detailed set of response bias tests are conducted in Hughes et al. (2016) and show little or no bias, indicating that the data is representative of the UK academic population.
2. Publications are missing mostly for academics at teaching institutions, in the arts, and for individuals with focus on teaching and applied research. Still, we cannot at this stage assume that missing have zero publications, and therefore need to drop these observations.
3. A principal component analysis (unreported) helps to determine potentially underlying common rationales of engagement. The Kaiser-Meyer-Olkin measure of sampling adequacy is 0.899. The Bartlett test of sphericity rejects the hypothesis that variables are not intercorrelated, confirming that the variables are suitable for factor analysis. The Crohnbach's alpha is 0.846 confirming that the scales are reliable.
4. HESA, Characteristics of Academic Staff in 2014/15, https://www.hesa.ac.uk/news/25-02-2016/academic-staff. Accessed: March 2022.

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ORCID

Cornelia Lawson http://orcid.org/0000-0002-1262-5142
Ammon Salter http://orcid.org/0000-0003-2065-1268

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Appendix

Table A1. Engagement activities.

Category	Engagement channels
Training	Company employee training
	Student placement
	Joint curriculum development
	Enterprise Education
	Social enterprise involvement
Meetings	Attending conferences
	Standard setting forums
	Participating in networks
	Sitting on advisory boards
	Giving invited lectures
	Consultancy services
	Informal advice
Research	Joint publications
	Hosting of personnel
	External secondment
	Joint research agreement
	Contract research
	Research consortia
Commercialisation	Setting up new physical facilities
	Prototyping and testing
	Taken out a patent
	Licensed research outputs to a company
	Formed a spin out company
	Formed or run a consultancy
Public engagement	Lectures for the community
	Performing arts and related cultural activities
	Museums and art galleries
	Heritage and tourism activities
	Public exhibitions
	Involvement with school projects

Note: The survey also asked about community sports which is not assigned to any category.